Rice and Sturgeon Lakes Nutrient Budget Study

The Zooplankton of
Rice and Sturgeon Lakes
1986 - 1988
Kawartha Lakes, Ontario

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THE ZOOPLANKTON OF RICE AND STURGEON LAKES,

1986-1988,

KAWARTHA LAKES, ONTARIO.

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for

The Rice-Sturgeon Lakes Nutrient Budget
Technical Committee

PREFACE

The Kawartha lakes are a large and economically important system of eight lakes which are located in central Ontario. Sturgeon Lake and Rice Lake are located near the upper and lower ends of the Kawartha Lakes system respectively and both support significant amounts of urban and recreational development. They were chosen for detailed study because of their importance within the system and because both have shown the symptoms associated with excessive nutrient input for several years.

The Rice and Sturgeon Lakes Nutrient Budget Study was initiated to investigate linkages between point and non-point sources of nutrients, water quality, and aquatic life within the lakes and to estimate the impacts of these processes on in-lake and downstream water quality.

The study was supervised by the Rice - Sturgeon Lakes Nutrient Budget Technical Committee which had representatives from the Limnology Section (Water Resources Branch) and Central Region of the Ministry of the Environment, the Trent Severn Waterway (Environment Canada) and the Kawartha Lakes Fisheries Assessment Unit of the Ministry of Natural Resources.

This is one of a series of technical reports. These and the summary report (R/S Tech. Rep. No. 13) will provide a technical basis for the management of the Rice Lake and Sturgeon Lake ecosystems and for the use of land and water resources in the Kawartha Lakes region in general. A list of all reports in the R/S Tech. Rep. series is as follows:

1. Hutchinson N.J., B.J. Clark,, J.R. Munro and B.P. Neary 1994. Hydrological data for the watersheds of Rice Lake and Sturgeon Lake.1986 - 1989, 100 pp.

2. Hutchinson N.J., J.R. Munro, B.J. Clark and B.P. Neary. 1994. Water chemistry data for Rice Lake, Sturgeon Lake and their respective catchments 1986-1989, 169 pp.

3. Hutchinson N.J., B.J. Clark J.R. Munro and B.P. Neary, 1994. Nutrient Budget data for the watersheds of Rice Lake and Sturgeon Lake. 120 pp.

4. Ryback, M. and I. Rybak. 1994. Sediment pigment stratigraphy as evidence of long term changes in primary productivity of Sturgeon and Rice Lakes (Kawartha Lakes). 24 pp.

5. Nicholls, K.H., M.F.P. Michalski and W. Gibson. 1994. Trophic interactions in Rice Lake I: An experimental demonstration of effects on water quality.

6. Limnos Ltd. 1994. Partitioning of phosphorus in *Potamogeton crispus*. 22 pp.

7. Limnos Ltd. 1994. Rice Lake Macrophytes: distribution, composition, biomass, tissue nutrient content and ecological significance. 123 pp.

8. Beak Consultants Ltd. 1994. Release of phosphorus from Rice Lake sediments. 31 pp .

9. Limnos Ltd., Michael Michalski Associates and D.J. McQueen. 1994. Trophic interactions in Rice Lake II. Young-of-the-year yellow perch - *Daphnia* interactions, preliminary findings. 101 pp.

10. Badgery, J.E., D.J. McQueen, K.H. Nicholls and P.R.H. Schaap. 1994. Trophic interactions in Rice Lake III: Potential for biomanipulation. 1988 and 1989 .

11. Standke, S. 1994. The zooplankton of Rice Lake and Sturgeon Lakes, 1986-1988, Kawartha Lakes, Ontario .

12. Nicholls, K.H. 1994. The phytoplankton - water quality relationships of the Kawartha Lakes, 1972-1989.

13. Hutchinson, N.J., K.H. Nicholls and S. Maude, 1994. Rice and Sturgeon Lake Nutrient Study: Summary and recommendations.

ABSTRACT

In 1972, a joint Ministry of Natural Resources and Ministry of the Environment (now Ministry of Environment and Energy) survey on the biological and physical-chemical status of the Kawartha Lakes was conducted to establish a water quality profile to which subsequent surveys could be compared. Two lakes, Rice and Sturgeon, to be resurveyed from 1986 to 1988 to determine if any changes in their zooplankton communities had occurred during the 14 year period.

The zooplankton populations of both Rice Lake and Sturgeon Lake have significantly changed from 1972. Densities in Rice Lake rose from a 1972 summer mean of 93,300 individuals per cubic meter to a high of 436,878 individuals per cubic meter in 1987. Similarly Sturgeon Lake zooplankton populations increased from a summer mean of 24,200 individuals per cubic meter to 251,292 in 1987. Densities and biomasses of the major groups in both lakes significantly dropped in 1988 but did not reach the levels of 1972. No significant differences in densities and biomasses for the major groups were observed between 1986 and 1987 although a sampling gear change implemented between these two years made strict comparisons difficult.

The percentage composition of the planktonic crustaceans also changed from 1972. The 1986-1988 survey average for Rice Lake showed that the

percentage contribution of the cladocerans to the zooplankton community rose from 66.6% to 82.3%. The calanoid copepods also increased from 1.7% to 6.4% and the cyclopoid copepods decreased from 18.9% to 11.2%. Similar results occurred in Sturgeon Lake. The cladocerans increased from 53.5% to 74.4%, the calanoid copepods increased from 4.3% to 9.4%, and the cyclopoid copepods decreased from 25.2% to 16.2%

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INTRODUCTION

In 1972, the Ministries of the Environment and Natural Resources conducted an extensive biological and physical-chemical survey of the Kawartha Lakes system to establish a water quality profile to which subsequent results could be compared. In 1976, many water quality parameters were remeasured and results indicated little change had occurred. A number of recommendations were made at the time the initial report was released in regards to upgrading sewage treatment and septic systems for more efficient use, limiting development, and reducing the nutrient loading of the area especially through changes in land use practices involving pesticides and fertilizers.

By the mid - 1980s, it was decided to resurvey the zooplankton communities of two of the most eutrophic of the Kawartha Lakes - Rice and Sturgeon, to determine if significant changes had occurred over the past decade. Also, it was important to establish a "before" senario for the plankton communities in anticipation of the inevitable introduction of the zebra mussel and spiny water flea into these lakes. Densities and species composition at this level of the food chain are likely to be the first effected by changes in food availability with subsequent impacts on the populations of higher levels of the ecosystem that depend on them for food.

This report summarizes the species composition, densities, and biomasses of the zooplankton communities observed in Rice and Sturgeon Lakes during the survey period

(summer months of 1986, 1987, 1988) and compares the results to those reported in 1972.

METHODOLOGY

A) Field Methods

Four stations on Rice Lake and six on Sturgeon Lake were sampled biweekly (May to October) during 1986, 1987, and 1988. Zooplankton samples were collected with a Wisconsin net (1986) and a Clarke-Bumpus net (1987, 1988) through a vertical water column starting approximately 1 metre from the lake bottom. The net contents were preserved with a 4% sugar formalin solution.

B) Laboratory Methods

The zooplankton samples were subsampled using a Folsom plankton splitter. Individuals were microscopically enumerated (minimum of 250 per sample) and the length of each organism measured (see apparatus description by Roff & Hopcroft, 1986). All organisms were identified to species level where possible with the exception of the copepod nauplii which were identified to the suborder level. Rotifers were not included in any of the years surveyed.

Densities are expressed as numbers per cubic metre and biomass as dry weight based on a length - weight relationship (Allen & Yan, 1993). Paired t-tests were performed on logrithmic transformed data using SYSTAT (Wilkinson, 1990). Taxonomic

references included Edmondson (1959), Brooks (1959), Deevey & Deevey (1971), Dodson (1981), and Korinek (1981). The samples were analyzed by Dr. Wm. Geiling, Lansdowne, Ontario and the density graphs located in the appendix were created by Michael Michalski Associates.

RESULTS

A total of thirty-five species were identified from Rice Lake during the survey period; 20 cladocerans, 7 calanoid copepods and 8 cyclopoid copepods (Table 2). Forty-one species were identified from Sturgeon Lake during the same time period; 23 cladocerans, 6 calanoid copepods, and 12 cyclopoid copepods (Table 1).

Cladocerans as a group dominated the zooplankton communities in both lakes in all years at all stations both in terms of numbers and biomass. Numbers were generally higher in Rice Lake (Figs. 1 - 3) with maximum densities occurring on May 8, 1986, Sept. 10, 1987, and June 14, 1988. The dominate organisms were Chydorus sphaericus (1986 & 1987) and Daphnia galeata mendotae (1988) (Table 8). In Sturgeon Lake, the maximum densities occurred on Sept. 10, 1986, May 26, 1987, and Sept. 27, 1988 (Figs. 4 - 6). The dominant organisms were Eubosmina coregoni in 1986, Bosmina longirostris in 1987, and Eubosmina coregoni and Daphnia rosea (tied) in 1988 (Table 13).

TABLE 1 Zooplankton species list for Sturgeon Lake, 1986 - 1988

CLADOCERA
Acroperus harpae Baird
Alona sp.
Bosmina longirostris O.F.Muller
Ceriodaphnia lacustris Birge
Ceriodaphnia sp.
Chydorus sphaericus O.F.Muller
Daphnia dubia Herrick
Daphnia galeata mendotae Birge
Daphnia parvula Fordyce
Daphnia pulex Richard
Daphnia retrocurva Forbes
Daphnia rosea Sars
Daphnia schoedleri Sars
Diaphanosoma brachyurum Lieven
Eubosmina coregoni Baird
Holopedium gibberum Zaddach
Leptodora kindtii Focke
Pleuroxus hamulatus Birge
Polyphemus pediculus Linne
Sida crystallina O.F.Muller
Simocephalus serrulatus Koch
Eubosmina longispina Leydig
Diaphanosoma birgei
Daphnia sp.

CALANOID COPEPODA
Calanoid copepodid
Diaptomus minutus Lilljeborg
Diaptomus oregonensis Lilljeborg
Epischura lacustris Forbes
Epischura lacustris copepodid
Calanoid nauplius

CYCLPOID COPEPODA
Cyclopoid copepodid
Cyclops bicuspidatus thomasi Forbes
Cyclops scutifer Sars
Cyclops vernalis Fischer
Eucyclops agilus Koch
Eucyclops speratus Lilljeborg
Macrocyclops albidus Jurine
Mesocyclops edax Forbes
Orthocyclops modestus Herrick
Paracyclops fimbriatus poppei Rehberg
Tropocyclops prasinus mexicanus Kiefer
Cyclopoid nauplius

TABLE 2 Zooplankton species list for Rice Lake, 1986 - 1988

CLADOCERA
<u>Alona affinis</u> Leydig
<u>Alona</u> sp.
<u>Bosmina longirostris</u> O.F.Muller
<u>Ceriodaphnia lacustris</u> Birge
<u>Ceriodaphnia</u> sp.
<u>Chydorus sphaericus</u> O.F.Muller
<u>Daphnia ambigua</u> Scourfield
<u>Daphnia galeata mendotae</u> Birge
<u>Daphnia longiremis</u> Sars
<u>Daphnia pulex</u> Richard
<u>Daphnia retrocurva</u> Forbes
<u>Diaphanosoma brachyurum</u> Lieven
<u>Eubosmina coregoni</u> Baird
<u>Eubosmina tubicen</u> Brehm
<u>Eurycercus lamellatus</u> O.F.Muller
<u>Leptodora kindtii</u> Focke
<u>Sida crystallina</u> O.F.Muller
<u>Diaphansoma birgei</u>

CALANOID COPEPODA
Calanoid copepodid
<u>Diaptomus ashlandi</u> Marsh
<u>Diaptomus minutus</u> Lilljeborg
<u>Diaptomus oregonensis</u> Lilljeborg
<u>Epischura lacustris</u> Forbes
<u>Epischura lacustris</u> copepodid
Calanoid nauplius

CYCLOPOID COPEPODA
Cyclopoid copepodid
<u>Cyclops bicuspidatus thomasi</u> Forbes
<u>Cyclops vernalis</u> Fischer
<u>Eucyclops agilus</u> Koch
<u>Mesocyclops edax</u> Forbes
<u>Tropocyclops prasinus mexicanus</u> Kiefer
Cyclopoid nauplius
<u>Macrocyclops ater</u> Herrick

The percentage composition and relative abundance of the cladoceran communities fluctuated from year to year (Table 21) in both lakes. In general, the smaller organisms such as Eubosmina coregoni, Chydorus sphaericus and Bosmina longirostris were the primary contributors to the populations in terms of density. The Daphnia component in Rice Lake, although lower in density, was the major contributor to the total biomass. Dominant species included Daphnia retrocurva, D. galeata mendotae, and in 1988, D. pulex. The same three species were found in Sturgeon Lake along with D. rosea which appeared in 1988.

The prominent cyclopoid copepods in both lakes were Mesocyclops edax, and Tropocyclops prasinus mexicanus, and to a lesser degree Cyclops vernalis and C. bicuspidatus thomasi. Diaptomus oregonensis was the dominant representative of the calanoid copepods with maximum numbers occuring in July and August.

DISCUSSION

Unfortunately, all the raw data for the zooplankton collections made during the 1972 survey (Hitchin, 1976) could not be found. Consequently, the only comparisons that could be made to the new survey results are with the data included in the original report (Hitchin, 1976).

There are several notable changes in the species composition of the zooplankton

communities during the 14 year period which in part may be due to taxonomic revisions. In 1972, 20% of the Cladocera observed from Sturgeon Lake samples were Daphnia catawba. Not one individual was found in the samples from this survey. Also Diaphanosoma leuchtenbergium has seemingly disappeared from both lakes being replaced by D. birgei.

Total densities of the zooplankton communities increased dramatically from the levels observed in 1972 (Tables 13 and 14) in both lakes. By doing a vertical tow starting 1 metre off the bottom, any spacial differences in the zooplankton populations especially due to vertical migration habits should be compensated for. However, there does appear to be a great deal of variability between the sampling stations in regards to densities of the communities and their biomasses for all three years in both lakes. Some of the variabilty may be a result of a sampling gear change that was made in 1987 when a Clarke-Bumpus net was put into service. But in 1988, a significant reduction in densities and biomasses was noted at stations in both lakes. In some cases, the biomasses of the zooplankton groups observed in 1988 were lower than those found in 1986 (Tables 3 - 7). Densities although lower than the previous years did not return to the levels observed in 1972 (Tables 8 -12).

RICE LAKE

When compared to the 1972 data, calanoid copepods make up a higher proportion of the zooplankton community (only 1.7% in 1972) in the 1986-88 survey

(Tables 15 - 17). This may be due in part to the grouping of the copepod nauplii into their respective categories. Cyclopoid copepods , however, decreased to 10.0% from the 1972 level of 18.9% (Hitchin, 1976) and cladocerans increased from 66.6% to a high of 85.3% in 1988.

The biomass of Daphnia and the total cladoceran community did not undergo any significant changes in Rice Lake during the study period (Tables 3 and 4). However densities at R35 did significantly decrease from 1987 to 1988 (Table 4).

Calanoid and cyclopoid copepods declined in biomass and densities at R34 from 1987 to 1988. At station R35, only the calanoid copepods decreased in biomass and densities. The cyclopoid copepods showed no significant changes in biomass but did in densities. Stations R33 and R36 did not have any significant changes in biomass or densities for the three year period (Tables 3 and 4).

Total zooplankton density and biomass did not undergo any major changes during the survey at R33. However, the densities at the other three stations declined significantly from 1987 to 1988 and a reduction in total zooplankton biomass was also observed at R34 (Tables 8 and 9).

At the conclusion of the 1972-1976 survey, the lakes were categorized into one of three categories depending on certain conditions that existed in the lake at that time.

Rice Lake was placed in category III ie. total phosphorus levels were greater than 40 μg/liter, chorophyll a concentrations were greater than 9.0 μg/l and the percentage of calanoid copepods present was less than 2% (Hitchin, 1976). During the 1986-88 survey, total P concentrations ranged from 21 to 50 μg/l , somewhat of an improvement from the average of 69 μg/l observed at R33 in 1972. Chlorophyll a values ranged from 7.4 to 20.4 μg/l (up from the 1972 range of 8.5 to 10.1 μg/l) and although the calanoid copepod populations declined from 1986 to 1988(8.3% to 4.8%), they still contributed more than 2% of the zooplankton community.

Although some reduction has been observed in the total P concentrations and the percentage composition of calanoid copepods has increased from the 1972 levels, based on the original criteria, the water quality has not improved enough for the lake to be reclassified from the III category.

Sturgeon Lake

In 1972, 4.3% of the zooplankton population was calanoid copepods, 17% nauplii, 25.2% cyclopoid copepods, and 53.5% cladocerans (Hitchin, 1976). Data collected during this survey indicate that the percentage composition of the zooplankton commmunity has changed. Cladocerans have increased from the 1972 levels, calanoid copepods have increased and cyclopoid copepods have decreased. There was one exception, station S8 which had a very low population of calanoids and a high population

of cyclopoids when compared to the other five stations during the same time period (Tables 13-15).

Even though the percentage contribution of some of the major groups to the total zooplankton communities appeared to have increased from 1972, t-test results indicated that major decreases in zooplankton biomass occurred in Sturgeon Lake from 1987 to 1988 and in some instances, biomass in 1988 was lower than in 1986. Only one difference was noted between the 1986 and 1987 data, a significant decline in the Daphnia biomass at S11 (Tables 5-7). Densities for all groups were significantly lower in 1988 from the levels of 1987 and in some instances, lower than 1986 (Tables 10 -12). No differences in the densities occurred between 1986 and 1987.

Originally, Sturgeon Lake was placed as a marginal category II lake at the conclusion of the 1972 survey (Hitchin, 1976). Total phosphorus concentrations were between 20 μg/l and 30 μg/l, chlorophyll a levels were greater than 4 μg/l, average zooplankton densities were between 10,000 and 40,000 individuals per cubic metre, and calanoid copepods represented 2% to 10% of the zooplankton population. From 1986 to 1988, total P concentrations ranged from 17 to 73 μg/l (the highest value at S8), chlorophyll a ranged from a low of 3.3 μg/l in 1986 at station S10 to a high of 21 μg/l at S8. Zooplankton densities increased (Table 14) to a maximum of 251,300 individuals per cubic metre in 1987, and the calanoid copepods represented between 1.5% (S8 in 1986) and 23.5% (S6 in 1988) of the zooplankton community (Tables 18 - 20).

These data showed that there was a great amount of variability in the parametres from year to year with the ranges overlapping between category II and III. Given that Sturgeon Lake was a marginal category II in 1972, such large increases in the zooplankton populations and higher levels of total phosphorus and chlorophyll a would indicate the lake now definitely fit into category III.

Zooplankton populations are usually controlled by water depth, water temperature, light, food supply, water chemistry, and predation pressures (Hutchinson, 1967). One or a combination of these factors may have caused the significant decline in the 1988 zooplankton populations of both lakes. Further investigation is required linking these parameters to the other aquatic communities (eg. fish) that were observed in 1988.

Additional changes in the zooplankton populations may occur now that the zebra mussel has found its way into the Kawartha Lakes system (L. Deacon, personal communication). The source of food for the calanoids copepods and cladocerans is algae (Hutchinson, 1967), the same source as for the zebra mussel. If the food supply for the zooplankton is depleted, young fish and adult planktivores that depend on the zooplanktors (especially the larger forms) as their source of food will be adversely affected. Thus the sport fish populations could become depleted thereby threatening the economy of the region that depends heavily upon the tourist industry.

SUMMARY

Zooplankton populations of both Rice and Sturgeon Lakes have changed significantly from 1972 especially in terms of density, and percentage composition in the major groups. Not much change was observed between 1986 and 1987 in the densities and biomasses although a change in sampling gear implemented between these two years made strict comparisons difficult. However, in 1988 the densities and biomasses of the major groups underwent a significant decline but still did not reach the levels observed in 1972.

Following an assessment of the criteria for categorizing lakes according to their trophic status, it was determined that Rice Lake was still in category III, and Sturgeon Lake which had been a marginal category II lake in 1972 had slipped into category III.

Additional changes in Rice Lake and Sturgeon Lake zooplankton communities may take place now that the zebra mussel has invaded inland lakes in Ontario. Since the invader and the zooplankton are competing for the same source of food (algae), food supplies may become limited. This will ultimately affect the higher levels of the food chain that depend on zooplankton for their food.

LITERATURE CITED

Allen, G., and Yan,N.D. 1993. ZEBRA - Zooplankton enumeration and biomass routines for APIOS, a semi automated sample processing system for zooplankton ecologists. Ont. Min. Env. Tech Report (in prep.).

Brooks, J.L. 1959. The systematics of North American Daphnia. Mem. Conn. Acad. Arts Sci. 13:1-180.

Deevey, E.S., and Deevey, G.B. 1971. The American species of Eubosmina Selig (Crustacea, Cladocera). Limnol Oceanogr. 16:201-218.

Dodson, S.I. 1981. Morphological variation of Daphnia pulex Leydig (Crustacea, Cladocera) and related species from North America. Hydrobiologic 83:101-114.

Edmondson, W.G. (ed.) 1959. Fresh - Water Biology. J.Wiley and Sons. 1248 pages.

Hitchin, G. 1976. The zooplankton of the Kawartha Lakes - 1972. in The Kawartha Lakes Water Management Study - Water Quality Assessment (1972 - 1976). M.O.E.

M.N.R. publication. 185 pages.

Hutchinson, G.E. 1967. A Treatise on Limnology. Volume II. Introduction to Lake Biology and the Limnoplankton. J. Wiley and Sons, Inc. 1115 pages.

Korinek, V. 1981. Diaphanosoma birgei n.sp. (Crustacea, Cladocera). A new species from America and its widely distributed subspecies Diaphanosoma birgei ssp. lacustris n.sp. Can. J. Zool. 59:1115-1121.

Roff, J.C., and Hopcroft, R.R. 1986. High precision micro computer based measuring system for ecological research. Can. J. Fish. Aquat. Sci. 43:2044-2048.

Wilkinson, Leland. 1990. SYSTAT : The System for Statistics. Evanston, IL:SYSTAT, Inc.

TABLE 3 Summer biomass of the dominant zooplankton groups in Rice Lake at stations R33 and R34 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. BIOMASS	MAY - OCT 1987 AVE. BIOMASS	MAY - OCT 1988 AVE. BIOMASS
R33	Total Cladocera	a,b,c	506.541	730.680	655.031
	Daphnia sp.	a,b,c	186.603	433.190	547.265
	Calanoid Copepods	a,b,c	87.195	34.532	19.977
	Cyclopoid Copepods	a,b,c	59.601	63.252	54.977
	Total Average Biomass	a,b,c	653.300	828.500	729.600
R34	Total Cladocera	a,b,c	337.096	411.965	127.807
	Daphnia sp.	a,b,c	142.466	258.476	91.143
	Calanoid Copepods	a,b	26.793	25.655	16.291
	Cyclopoid Copepods	a,b	47.474	48.651	22.458
	Total Average Biomass	a,b	411.400	486.400	166.7

1
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=8
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=8
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=10 (R33), 12 (R34)

TABLE 4 Summer biomass of the dominant zooplankton groups in Rice Lake at stations R35 and R36 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST RESULTS[1]	MAY - OCT 1986 AVE. BIOMASS	MAY - OCT 1987 AVE. BIOMASS	MAY - OCT 1988 AVE. BIOMASS
R35	Total Cladocera	a,b,c	501.607	458.725	322.279
	Daphnia sp.	a,b,c	265.790	190.640	237.562
	Calanoid Copepods	a,b	39.237	53.965	12.051
	Cyclopoid Copepods	a,b,c	68.862	82.732	37.678
	Total Average Biomass	a,b,c	609.700	595.400	372.100
R36	Total Cladocera	a,b,c	432.490	400.698	345.597
	Daphnia sp.	a,b,c	175.863	230.108	238.822
	Calanoid Copepods	a,b,c	40.053	31.848	12.452
	Cyclopoid Copepods	a,b,c	89.687	78.983	34.760
	Total Average Biomass	a,b,c	562.300	511.500	392.900

[1]
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=8
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=8
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=12 (R35), 11 (R36)

TABLE 5 Summer biomass of the dominant zooplankton groups in Sturgeon Lake at stations S6 and S7 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. BIOMASS	MAY - OCT 1987 AVE. BIOMASS	MAY - OCT 1988 AVE. BIOMASS
S6	Total Cladocera	a,b	175.914	181.062	51.346
	Daphnia sp.	a,b	153.931	150.030	40.724
	Calanoid Copepods	a,b,c	16.800	46.852	19.878
	Cyclopoid Copepods	a,b	21.982	43.878	13.544
	Total Average Biomass	a,b	214.700	271.900	84.700
S7	Total Cladocera	a	309.037	247.493	123.080
	Daphnia sp.	a	129.272	191.225	103.842
	Calanoid Copepods	a,b	7.464	34.261	8.778
	Cyclopoid Copepods	a	54.664	48.668	12.322
	Total Average Biomass	a	371.100	330.500	144.200

[1]
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=6 (S6), 5 (S7)
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=6 (S6), 5 (S7)
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=8

TABLE 6 Summer biomass of the dominant zooplankton groups in Sturgeon Lake at stations S8 and S9 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. BIOMASS	MAY - OCT 1987 AVE. BIOMASS	MAY - OCT 1988 AVE. BIOMASS
S8	Total Cladocera	a	318.305	412.853	91.655
	Daphnia sp.	a,b	236.629	196.812	61.664
	Calanoid Copepods	a,b,c	8.035	15.018	6.707
	Cyclopoid Copepods	a	196.495	195.746	49.235
	Total Average Biomass	a	522.800	623.700	147.600
S9	Total Cladocera	a	242.182	443.952	55.578
	Daphnia sp.	a,b	143.670	346.206	43.098
	Calanoid Copepods	a,b	8.809	44.545	6.738
	Cyclopoid Copepods	a,b,c	28.730	62.523	11.394
	Total Average Biomass	a	279.700	550.900	73.700

1
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=6
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=6
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=8

TABLE 7 Summer biomass of the dominant zooplankton groups in Sturgeon Lake at stations S10 and S11 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. BIOMASS	MAY - OCT 1987 AVE. BIOMASS	MAY - OCT 1988 AVE. BIOMASS
S10	Total Cladocera	a,b	182.284	327.227	77.968
	Daphnia sp.	a	124.638	253.625	59.631
	Calanoid Copepods	a,b	9.583	73.783	10.730
	Cyclopoid Copepods	a	22.775	48.539	9.202
	Total Average Biomass	a	214.700	449.500	97.800
S11	Total Cladocera	a	377.921	443.952	96.514
	Daphnia sp.		301.625	346.206	76.650
	Calanoid Copepods	a,b	32.567	44.545	22.374
	Cyclopoid Copepods	a	32.436	62.523	12.406
	Total Average Biomass	a	442.900	347.700	131.300

[1]
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=6
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=6
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=8

TABLE 8 Summer densities of the dominant zooplankton groups in Rice Lake at stations R33 and R34 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. DENSITY	MAY - OCT 1987 AVE. DENSITY	MAY - OCT 1988 AVE. DENSITY
R33	Total Cladocera	a,b,c	246078.1	389266.900	106221.000
	Daphnia sp.	a,b,c	32869.08	72025.550	48192.760
	Calanoid Copepods	a,b,c	14408.320	9746.320	7372.450
	Cyclopoid Copepods	a,b,c	39267.640	63799.580	37545.140
	Total Zooplankton	a,b,c	300217.300	462812.700	151138.600
R34	Total Cladocera	a,b,c	211011.2	293434.800	40555.19
	Daphnia sp.	a,b	27785.99	62814.580	13178.24
	Calanoid Copepods	a,b	10424.9	27535.270	4983.49
	Cyclopoid Copepods	a,b	43824.26	79693.150	24262.46
	Total Zooplankton	a,b	265260.400	390894.000	69801.15

[1]
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df = 8
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df = 8
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df = 12

TABLE 9 Summer densities of the dominant zooplankton groups in Rice Lake at stations R35 and R36 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. DENSITY	MAY - OCT 1987 AVE. DENSITY	MAY - OCT 1988 AVE. DENSITY
R35	Total Cladocera	a	210333.600	474782.300	65396.100
	Daphnia sp.	a,b,c	41990.580	40084.820	24511.690
	Calanoid Copepods	a,b	9724.980	17644.030	4769.820
	Cyclopoid Copepods	a,b	45819.170	63945.820	25292.290
	Total Zooplankton	a	265877.700	556372.000	95983.210
R36	Total Cladocera	a,b,c	205331.100	286749.500	74584.240
	Daphnia sp.	a,b,c	33556.100	35969.720	24580.410
	Calanoid Copepods	a,b,c	11733.230	11572.910	4949.790
	Cyclopoid Copepods	a,b,c	50910.960	67232.140	24816.290
	Total Zooplankton	a,b	267975.300	365554.600	104350.300

[1]
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df = 8
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df = 8
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df = 12 (R35), 11 (R36)

TABLE 10 Summer density of the dominant zooplankton groups in Sturgeon Lake at stations S6 and S7 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. DENSITY	MAY - OCT 1987 AVE. DENSITY	MAY - OCT 1988 AVE. DENSITY
S6	Total Cladocera	a	40037.500	39771.270	9195.990
	Daphnia sp.	a,b	17431.610	13363.920	4047.440
	Calanoid Copepods	a,b	8732.430	15113.260	12272.940
	Cyclopoid Copepods	a,b	20657.300	81641.990	16474.390
	Total Zooplankton	a,b	64730.000	136526.500	34877.670
S7	Total Cladocera	a	97251.130	83596.590	26542.020
	Daphnia sp.	a	15915.030	23774.840	8754.000
	Calanoid Copepods	a,b	3276.330	12241.090	3697.960
	Cyclopoid Copepods	a,b	36187.620	67745.940	15562.060
	Total Zooplankton	a	136715.100	163583.600	45802.030

1
a - no significant difference between 1986 and 1987. μ = 0.05, df=6 (S6), 5 (S7)
b - no significant difference between 1986 and 1988. μ = 0.05, df=6 (S6), 5 (S7)
c - no significant difference between 1987 and 1988. μ = 0.05, df=8

TABLE 11 Summer density of the dominant zooplankton groups in Sturgeon Lake at stations S8 and S9 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. DENSITY	MAY - OCT 1987 AVE. DENSITY	MAY - OCT 1988 AVE. DENSITY
S8	Total Cladocera	a	161605.000	38547.900	95902.900
	Daphnia sp.	a,b,c	56301.970	31467.700	37889.400
	Calanoid Copepods	a,b,c	5764.640	2501.240	2176.540
	Cyclopoid Copepods	a,b	129438.900	298898.200	68381.900
	Total Zooplankton	a	296808.500	687947.500	166664.800
S9	Total Cladocera	a	54985.140	10172.300	10527.490
	Daphnia sp.	a	16012.630	32168.190	3733.500
	Calanoid Copepods	a,b	3108.230	12231.430	2151.640
	Cyclopoid Copepods	a,b	17929.090	60174.810	12913.760
	Total Zooplankton	a	76011.700	173478.600	25592.890

1
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=6
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=6
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=8

TABLE 12 Summer density of the dominant zooplankton groups in Sturgeon Lake at stations S10 and S11 for 1986, 1987, and 1988.

STATION	ZOOPLANKTON GROUP	T-TEST[1] RESULTS	MAY - OCT 1986 AVE. DENSITY	MAY - OCT 1987 AVE. DENSITY	MAY - OCT 1988 AVE. DENSITY
S10	Total Cladocera	a	34938.890	91190.460	12564.280
	Daphnia sp.	a	11351.300	26139.870	5083.040
	Calanoid Copepods	a,b	5201.050	20247.990	3226.220
	Cyclopoid Copepods	a,b	15886.010	54724.370	9100.878
	Total Zooplankton	a	55434.500	166162.800	24903.130
S11	Total Cladocera	a	55595.600	59740.760	21224.880
	Daphnia sp.	a	23557.740	17074.660	7495.960
	Calanoid Copepods	a,b	10170.370	23799.420	11144.290
	Cyclopoid Copepods	a,b	18648.860	96513.100	12847.110
	Total Zooplankton	a	86213.100	180053.300	45216.300

1
a - no significant difference between 1986 and 1987. $\mu = 0.05$, df=6
b - no significant difference between 1986 and 1988. $\mu = 0.05$, df=6
c - no significant difference between 1987 and 1988. $\mu = 0.05$, df=8

TABLE 13 Crustacean zooplankton concentration in Rice Lake.

YEAR	SUMMER MEAN DENSITY (individuals / m^3)	MAXIMUM DENSITY (individuals / m^3)
1972	93,300	352,600
1986	206,125	544,955
1987	436,878	2,719,896
1988	107,233	124,619

TABLE 14 Crustacean zooplankton concentration in Sturgeon Lake.

YEAR	SUMMER MEAN DENSITY (individuals / m^3)	MAXIMUM DENSITY (individuals / m^3)
1972	24,200	70,700
1986	116,850	264,078
1987	251,292	937,217
1988	57,174	234,402

TABLE 15 Percentage composition of the zooplankton in Rice Lake, 1986.

GROUP \ STATION	R33	R34	R35	R36
Total Cladocera	77.5	81.9	82.2	76.9
Daphnia sp.	28.6	34.6	43.6	31.3
Calanoid copepods	13.3	6.5	6.4	7.1
Cyclopoid copepods	9.1	11.5	11.3	15.95

TABLE 16 Percentage composition of the zooplankton in Rice Lake, 1987.

GROUP \ STATION	R33	R34	R35	R36
Total Cladocera	88.2	84.7	77.0	78.3
Daphnia sp.	52.3	53.1	32.0	44.98
Calanoid copepods	4.2	5.3	9.1	6.2
Cyclopoid copepods	7.6	10.0	13.9	15.4

TABLE 17 Percentage composition of the zooplankton in Rice Lake, 1988.

GROUP \ STATION	R33	R34	R35	R36
Total Cladocera	89.8	76.7	86.6	87.96
Daphnia sp.	75.0	54.6	63.9	60.8
Calanoid copepods	2.7	9.8	3.3	3.2
Cyclopoid copepods	7.5	13.5	10.1	8.9

TABLE 18 Percentage composition of the zooplankton in Sturgeon Lake, 1986.

GROUP \ STATION	S6	S7	S8	S9	S10	S11
Total Cladocera	81.98	83.3	60.9	86.6	84.9	85.3
Daphnia sp.	71.7	34.8	45.3	51.4	58.0	68.1
Calanoid copepods	7.8	2.0	1.5	3.1	4.5	7.4
Cyclopoid copepods	10.2	14.7	37.6	10.3	10.6	7.3

TABLE 19 Percentage composition of the zooplankton in Sturgeon Lake, 1987.

GROUP \ STATION	S6	S7	S8	S9	S10	S11
Total Cladocera	66.6	74.8	66.2	80.6	72.8	57.7
Daphnia sp.	55.2	57.9	31.6	62.8	56.4	46.7
Calanoid copepods	17.2	10.4	2.4	8.1	16.4	17.8
Cyclopoid copepods	16.1	14.7	31.4	11.3	10.8	24.5

TABLE 20 Percentage composition of the zooplankton in Sturgeon Lake, 1988.

GROUP \ STATION	S6	S7	S8	S9	S10	S11
Total Cladocera	60.6	85.4	62.1	75.4	79.6	73.5
Daphnia sp.	48.1	71.98	41.8	58.5	60.9	58.4
Calanoid copepods	23.5	6.1	4.5	9.1	10.9	17.1
Cyclopoid copepods	15.9	8.5	33.3	15.5	9.4	9.4

Table 21 Percent composition of Cladocera in Rice and Sturgeon Lakes.

	RICE LAKE			STURGEON LAKE		
	1986	1987	1988	1986	1987	1988
Acroperus harpae	-	-	<1	<1	-	-
Alona affinis	-	<1	-	-	-	-
Alona sp.	<1	<1	<1	<1	-	<1
Bosmina longirostris	2	9	9	9	22	14
Ceriodaphnia lacustris	1	1	<1	3	<1	<1
Ceriodaphnia sp.	<1	<1	<1	<1	1	1
Chydorus sphaericus	40	60	26	30	41	20
Daphnia ambigua	-	-	<1	-	-	-
Daphnia dubia	-	-	-	-	-	<1
Daphnia galeata mendotae	6	2	26	12	6	6
Daphnia longiremis	-	-	<1	-	<1	-
Daphnia parvula	-	-	-	-	<1	-
Daphnia pulex	<1	<1	6	8	11	12
Daphnia retrocurva	9	12	5	12	2	5
Daphnia rosea	-	-	-	-	-	15
Daphnia schoedleri	-	-	-	-	<1	-
Diaphanosoma brachyurum	<1	<1	-	-	<1	-
Eubosmina coregoni	40	14	24	21	13	24
Eubosmina tubicen	<1	-	-	-	<1	-
Eurycercus lamellatus	-	<1	<1	-	-	-
Holopedium gibberum	-	-	-	<1	<1	<1
Leptodora kindtii	<1	<1	<1	<1	<1	<1
Pleuroxus hamulatus	-	-	-	-	-	<1
Polyphemus pediculus	-	-	<1	<1	<1	<1
Sida crystallina	<1	<1	<1	-	<1	<1
Simocephalus serrulatus	-	-	-	<1	-	-
Eubosmina longispina	-	-	-	-	<1	-
Diaphanosoma birgei	1	<1	2	5	3	3

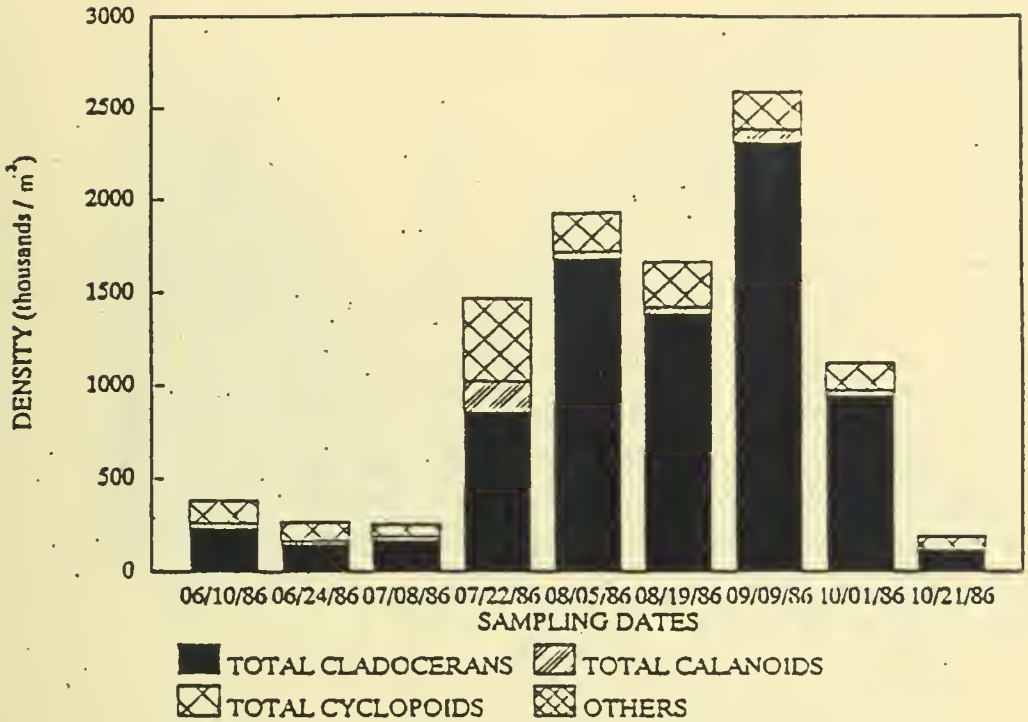


Figure 1 Relative abundance of the four major zooplankton groups in Rice Lake, 1986.

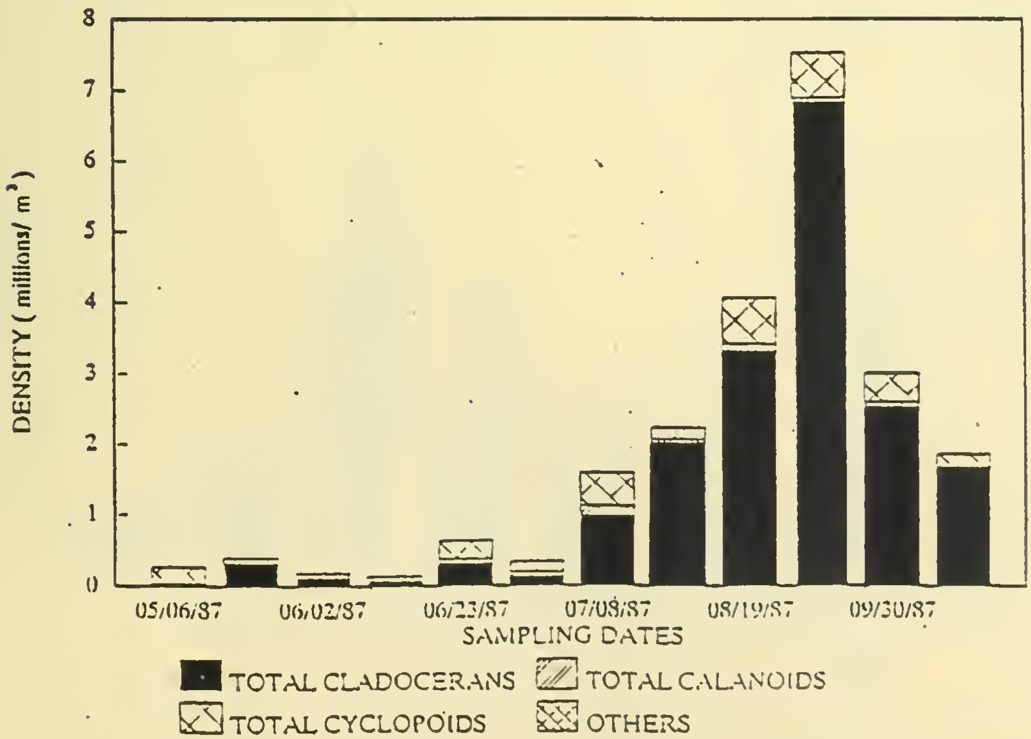


Figure 2 Relative abundance of the four major zooplankton groups in Rice Lake, 1987.

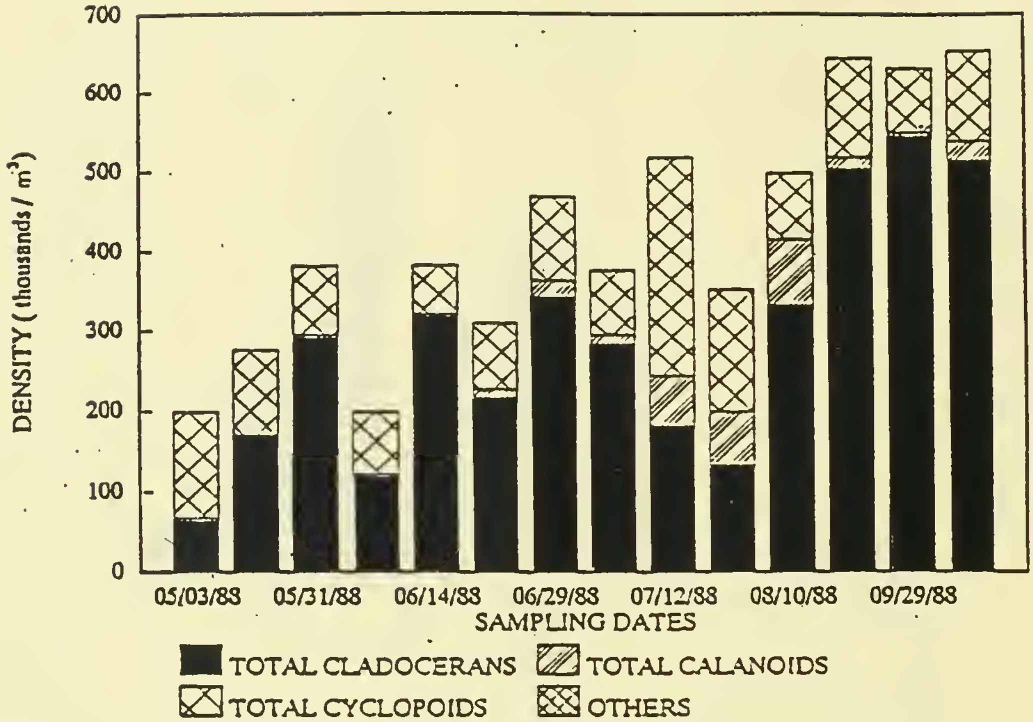


Figure 3 Relative abundance of the four major zooplankton groups in Rice Lake, 1988.

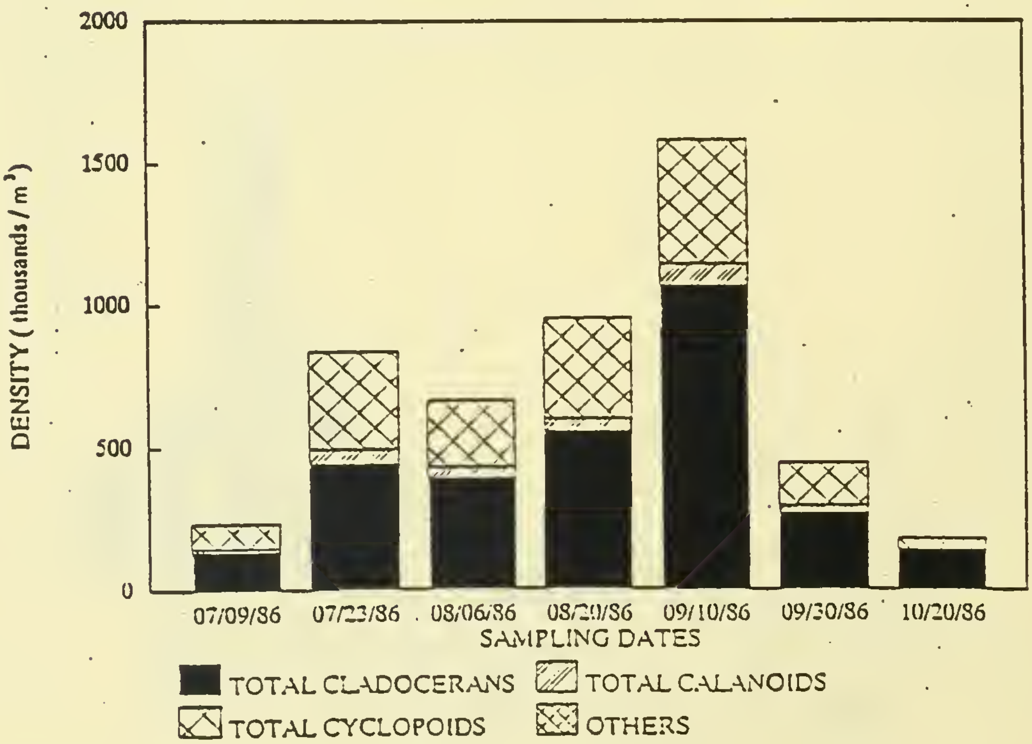


Figure 4 Relative abundance of the four major zooplankton groups in Sturgeon Lake, 1986.

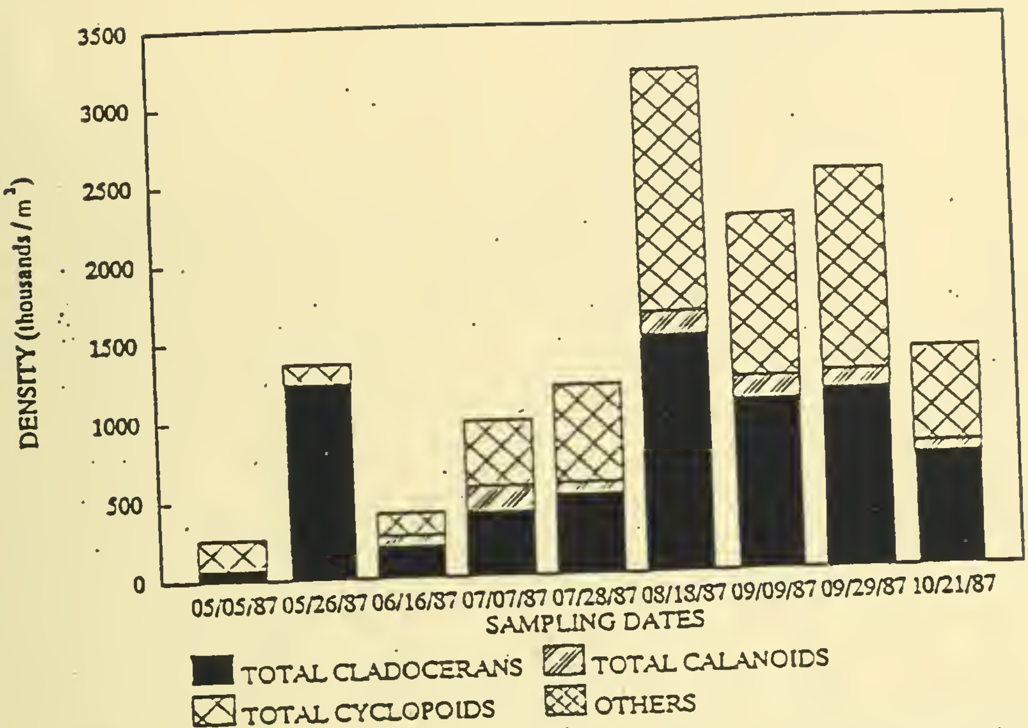


Figure 5 Relative abundance of the four major zooplankton groups in Sturgeon Lake, 1987.

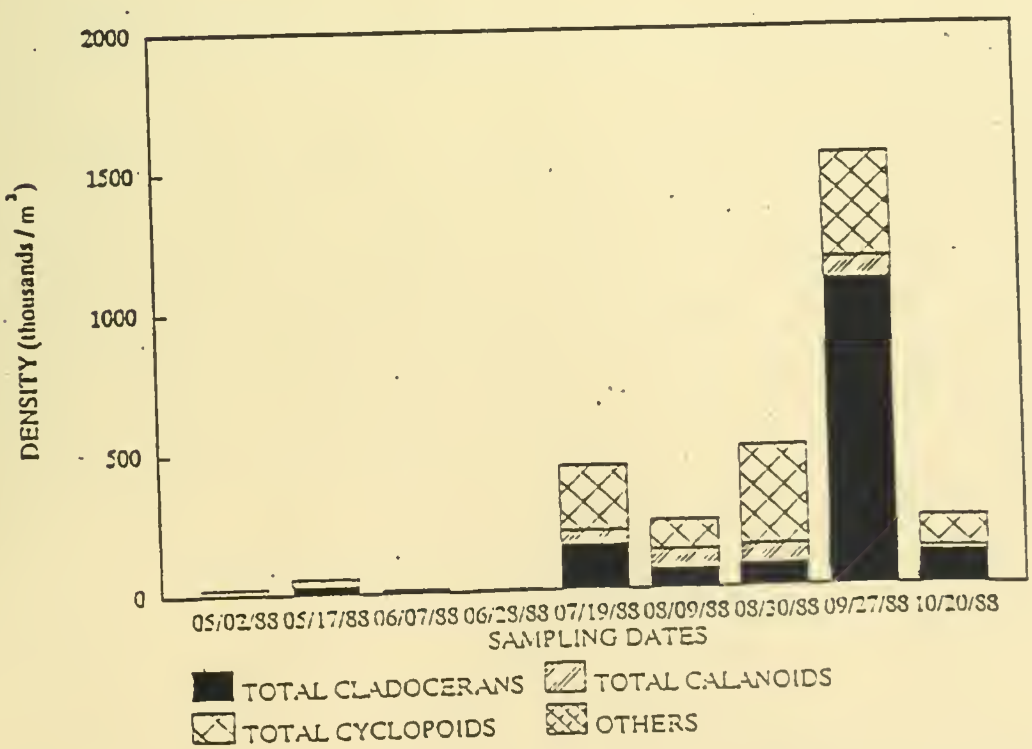
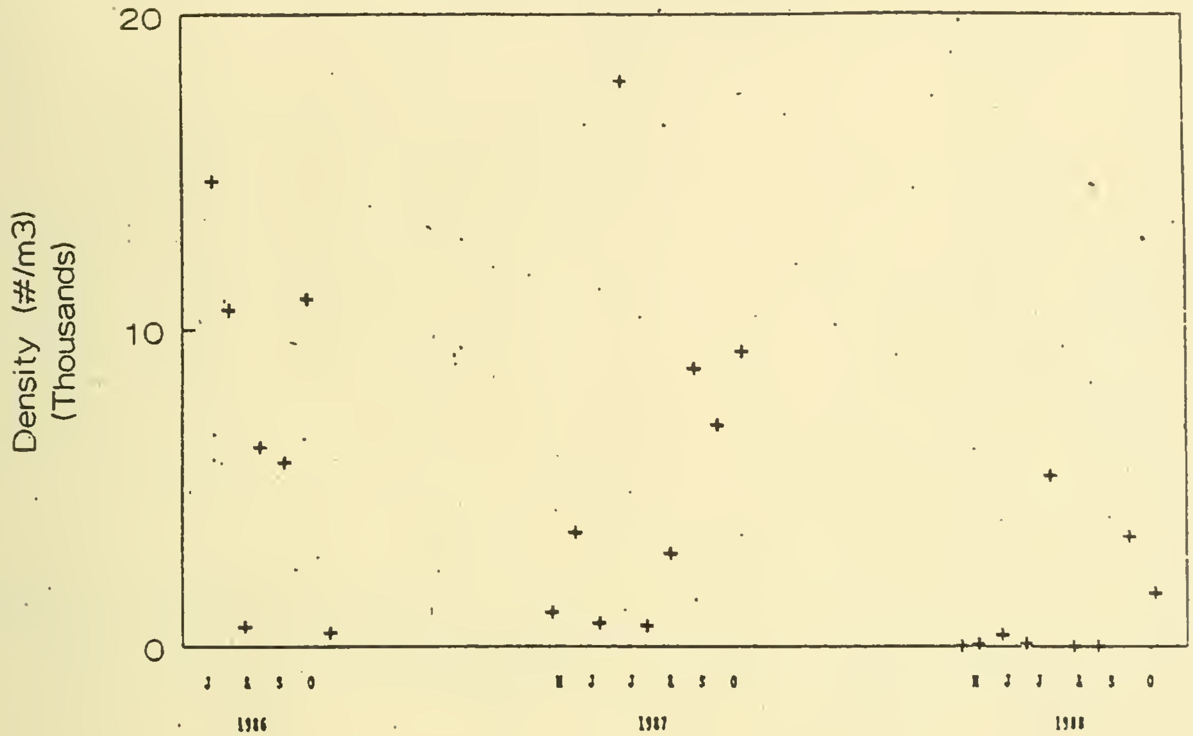


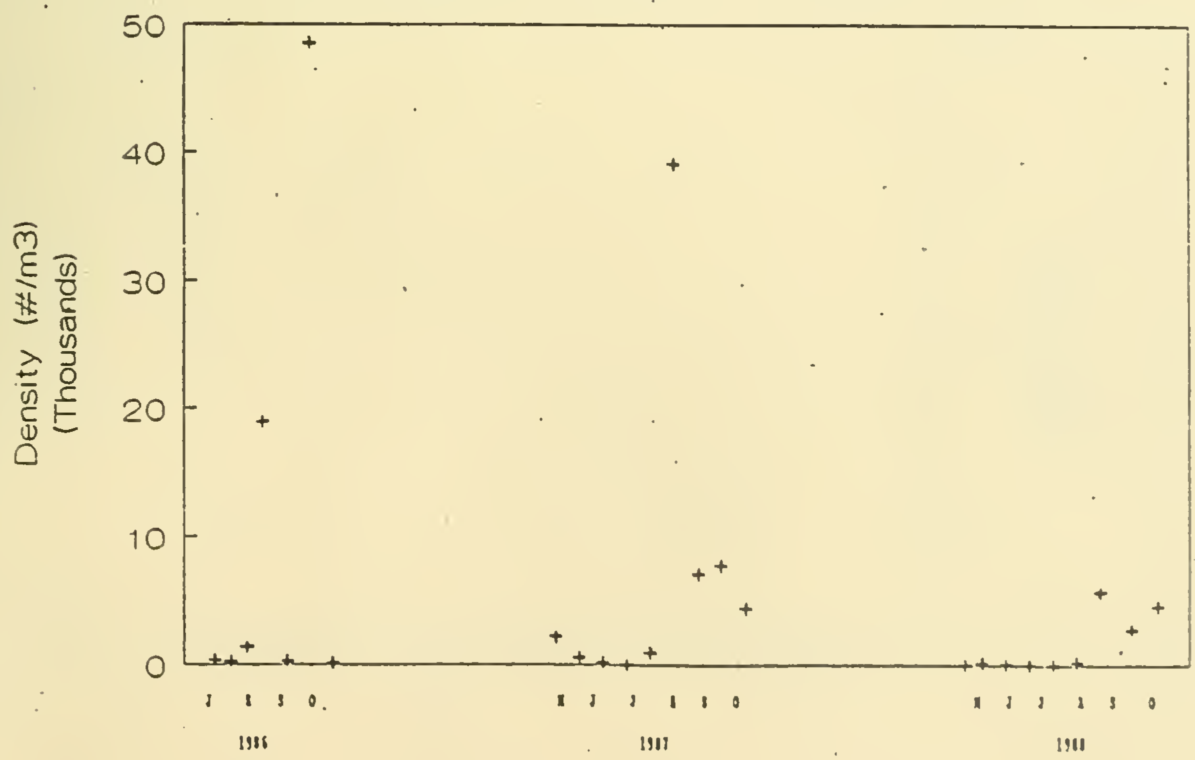
Figure 6 Relative abundance of the four major zooplankton groups in Sturgeon Lake, 1988.

APPENDIX

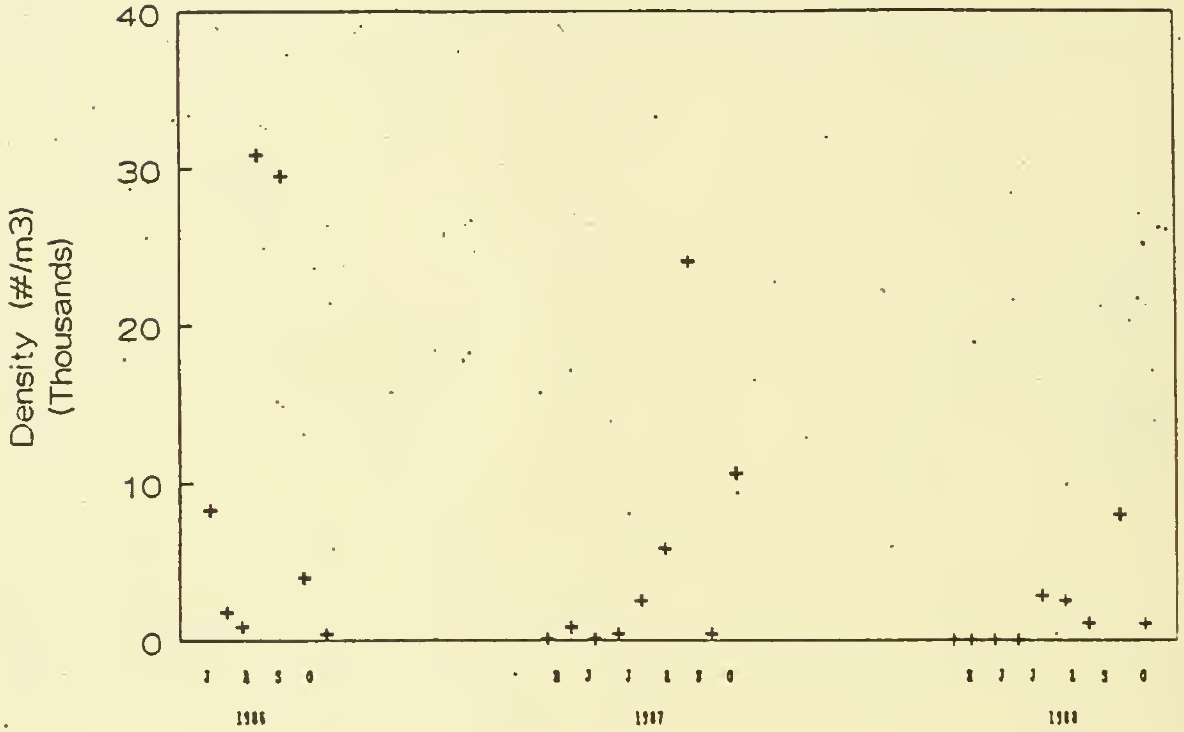
Density of Bosmina longirostris
Sturgeon Lake - Station S6



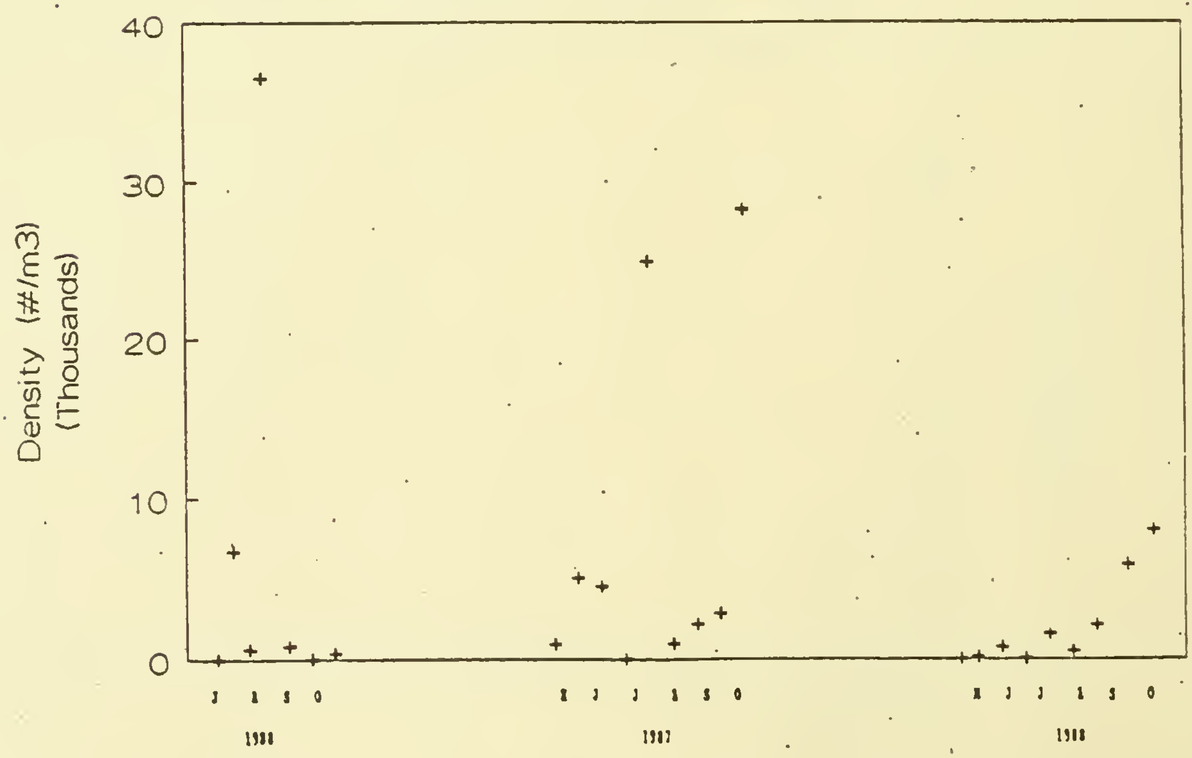
Density of Chydorus sphaericus
Sturgeon Lake - Station S6



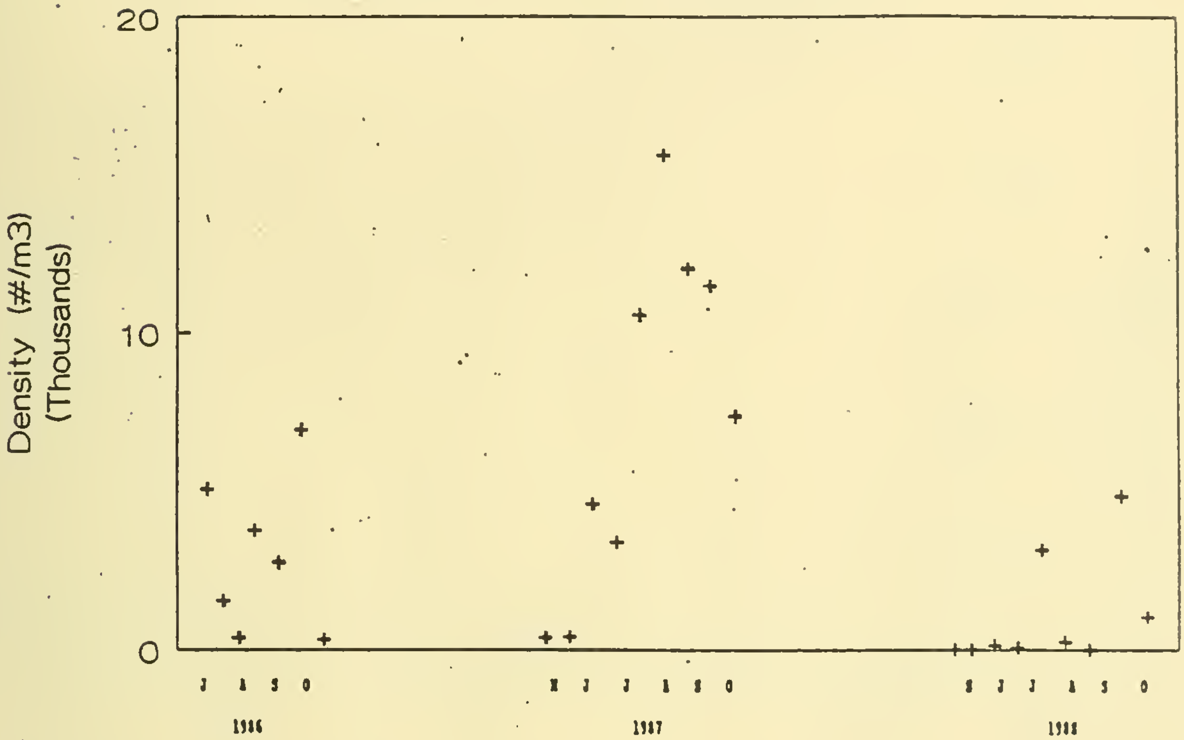
Density of Daphnia galeata mendotae
Sturgeon Lake - Station S6



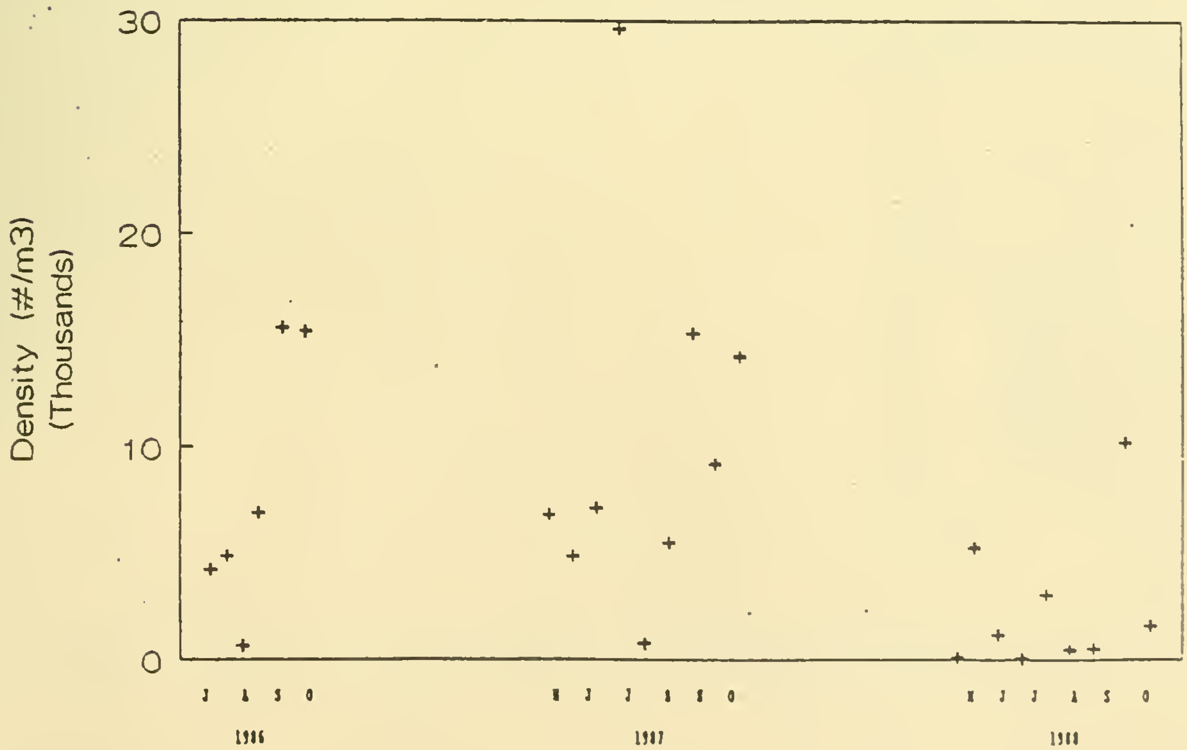
Density of Daphnia pulex
Sturgeon Lake - Station S6



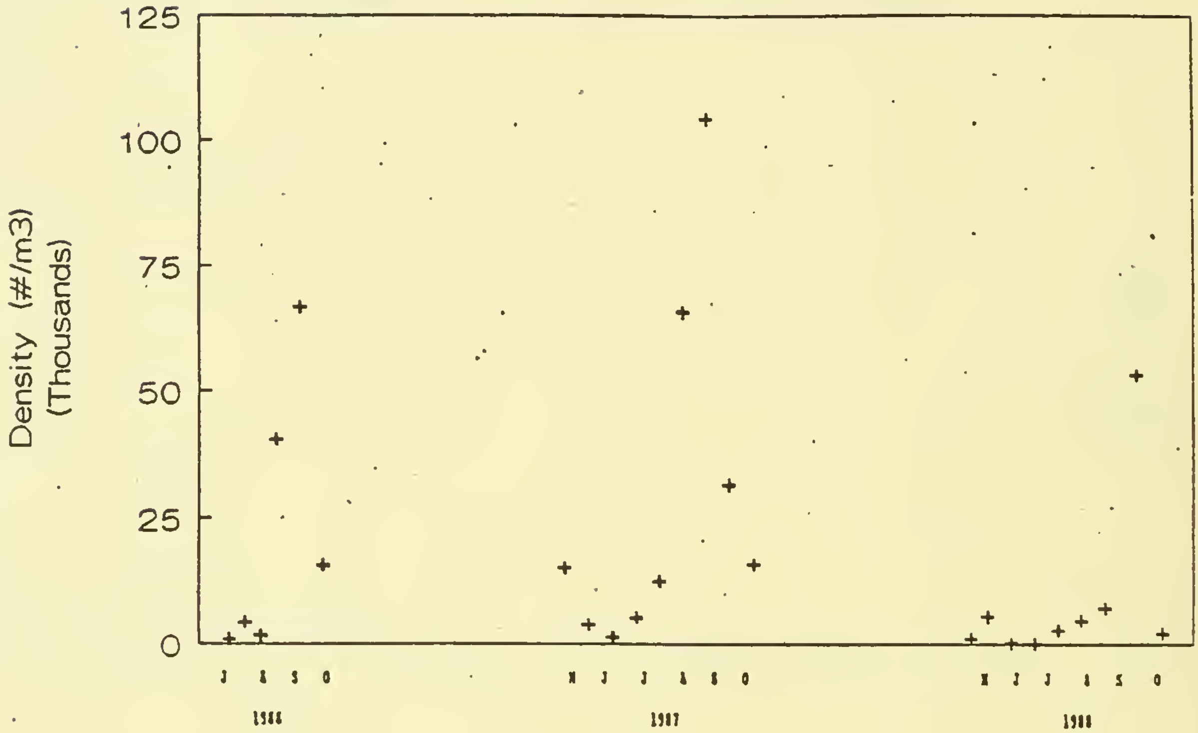
Density of Eubosmina coregoni
Sturgeon Lake - Station S6



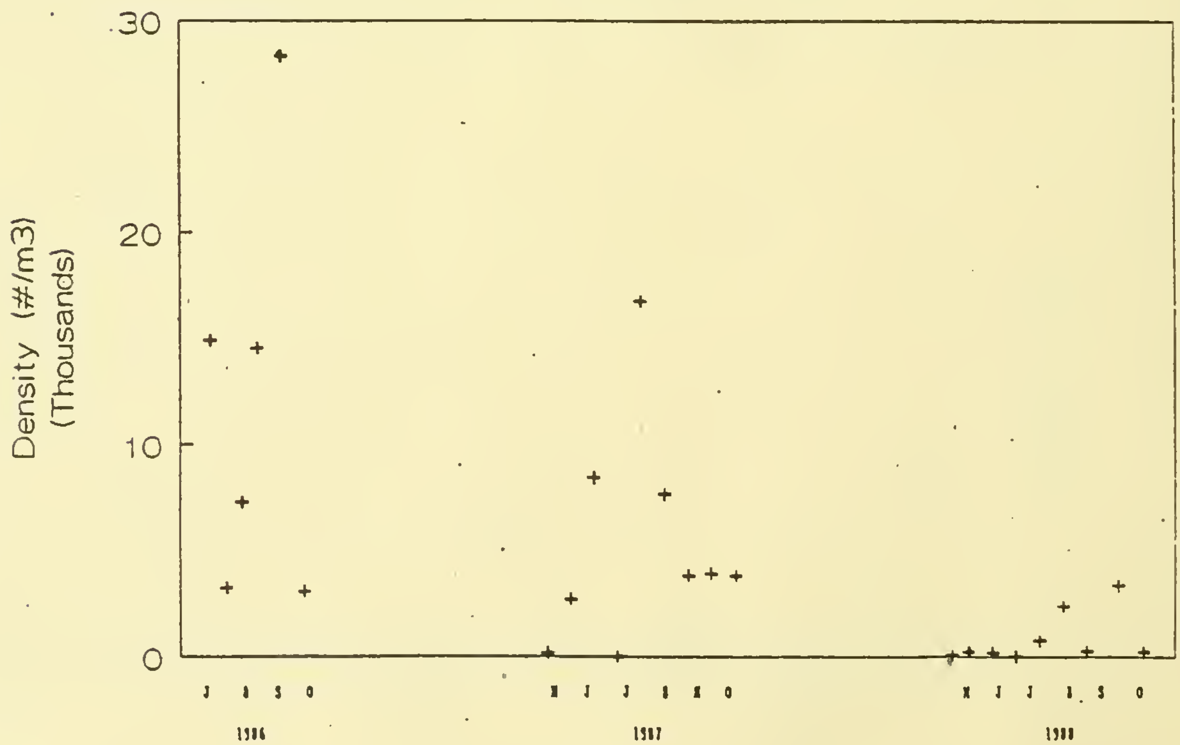
Density of Bosmina longirostris
Sturgeon Lake - Station S7



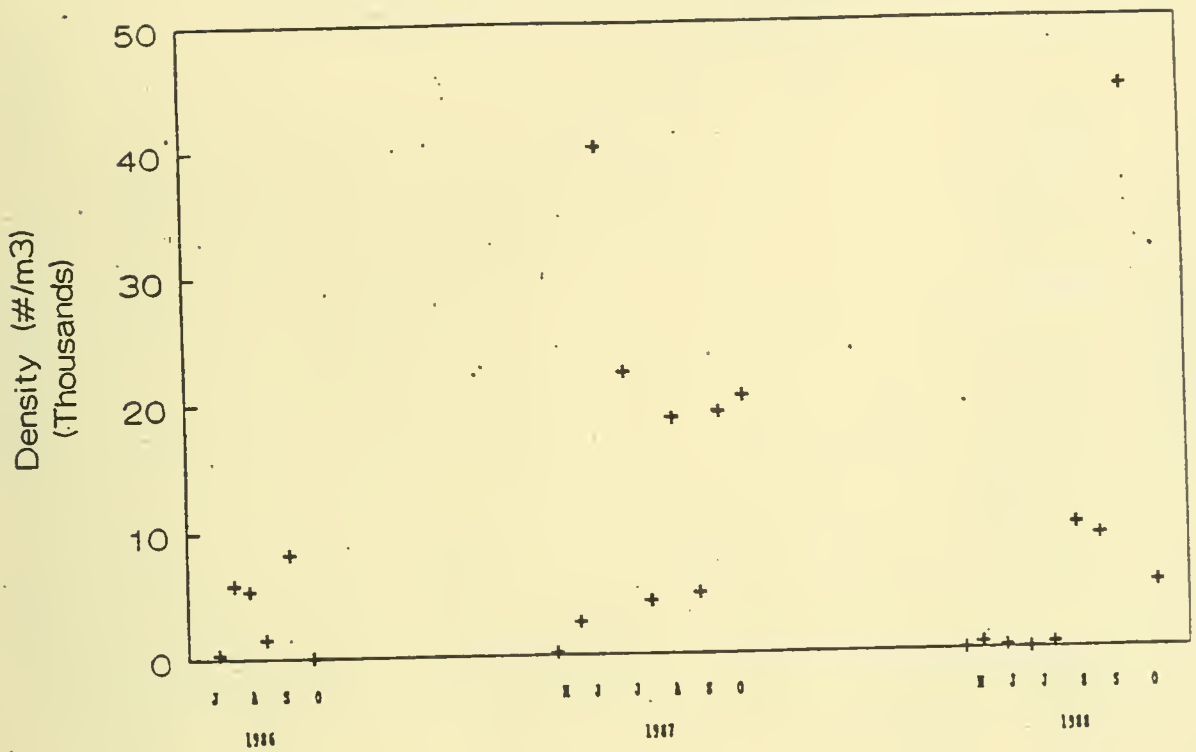
Density of Chydorus sphaericus
Sturgeon Lake - Station S7



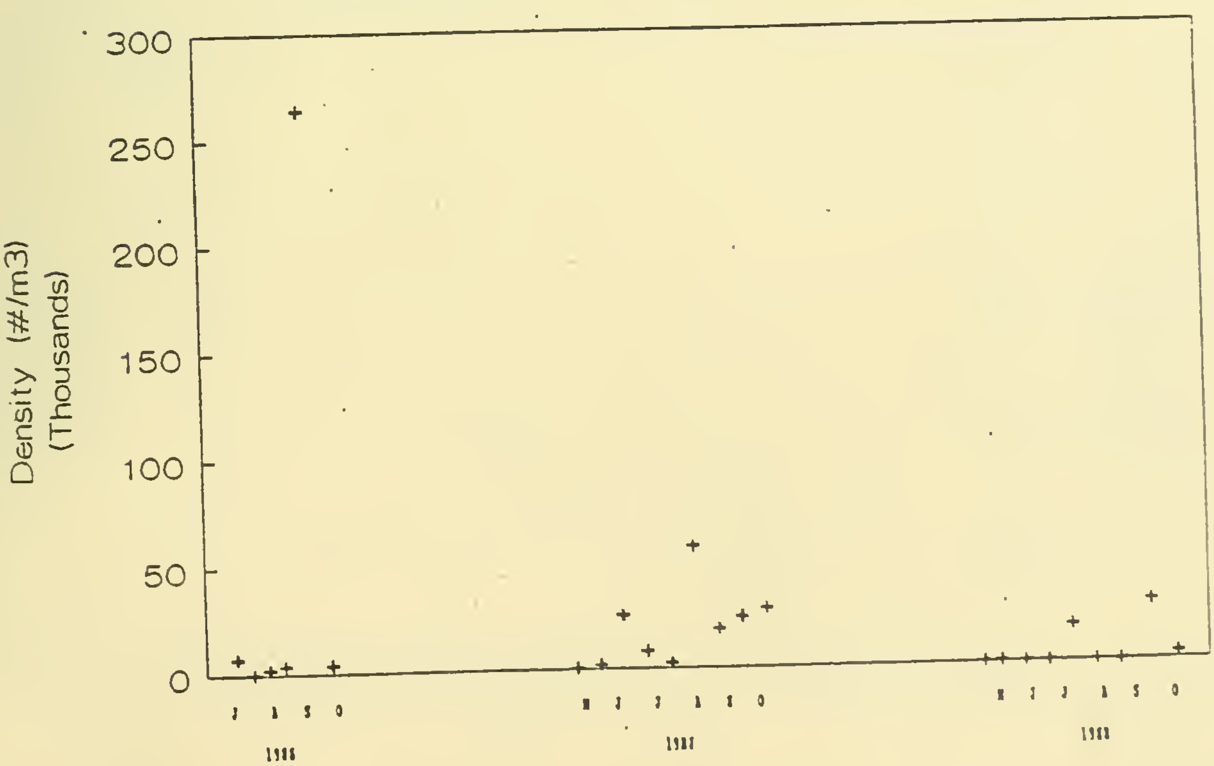
Density of Daphnia galeata mendotae
Sturgeon Lake - Station S7



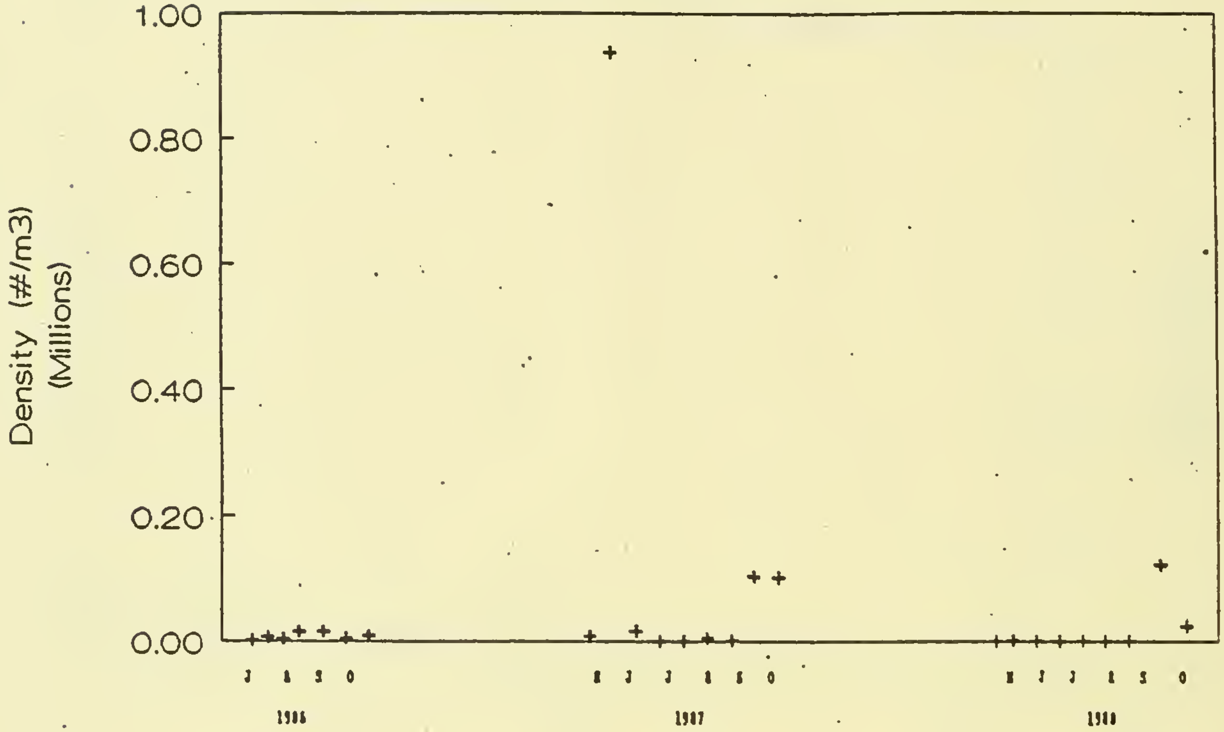
Density of Daphnia pulex
Sturgeon Lake - Station S7



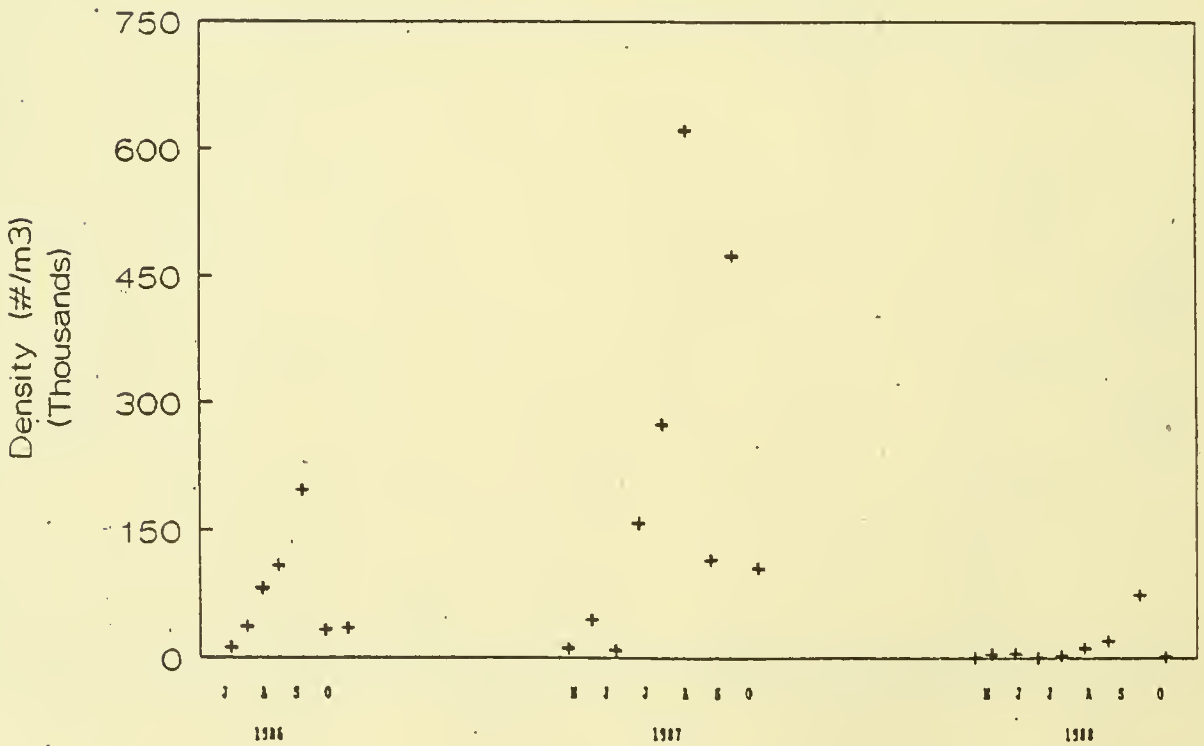
Density of Eubosmina coregoni
Sturgeon Lake - Station S7



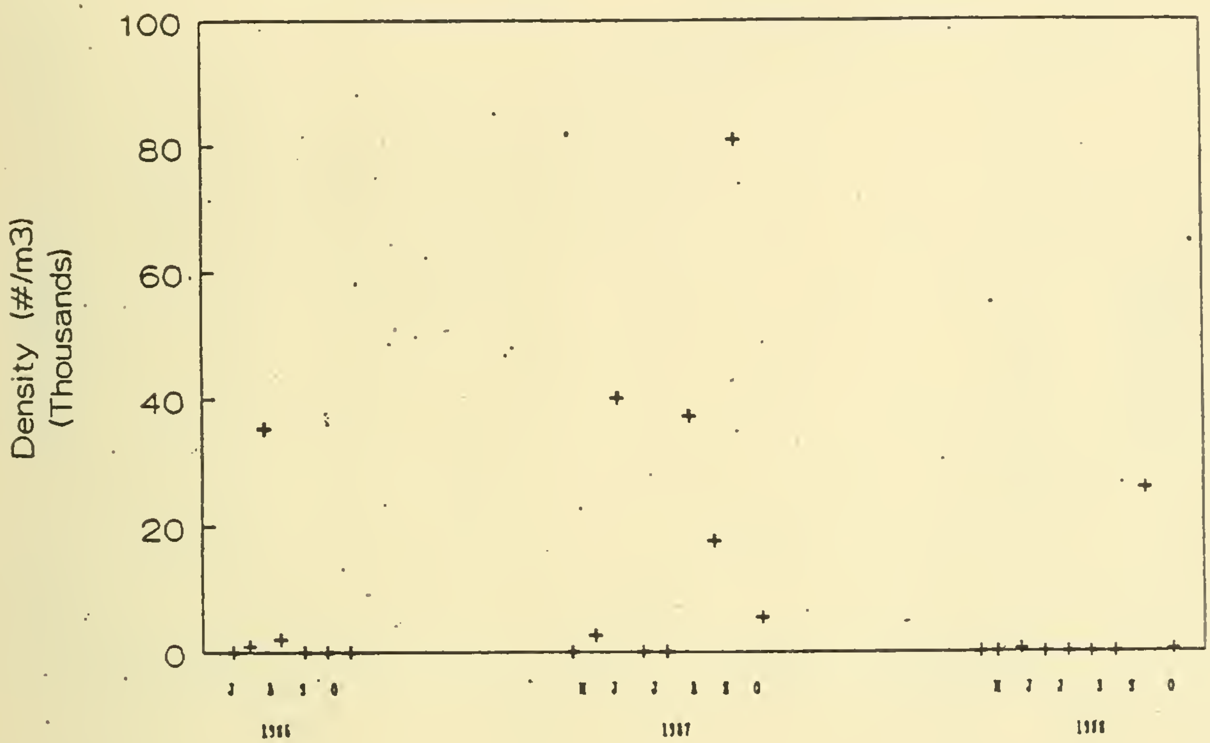
Density of Bosmina longirostris
Sturgeon Lake - Station S8



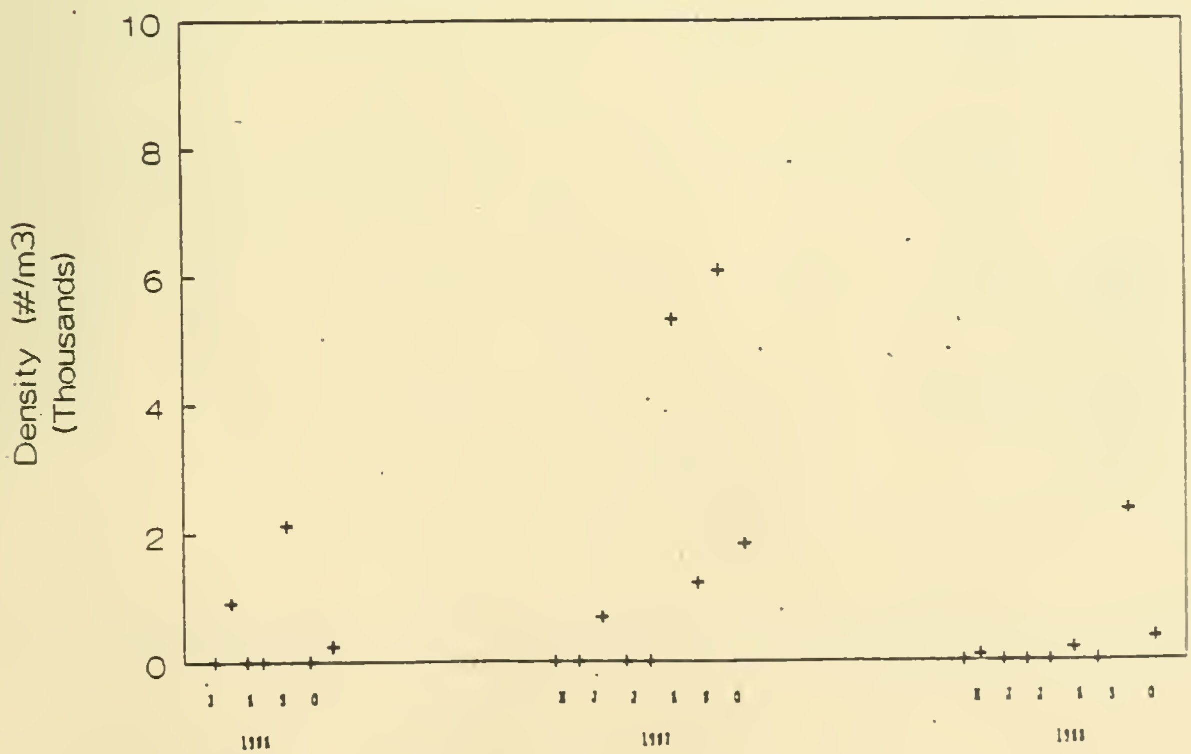
Density of Chydorus sphaericus
Sturgeon Lake - Station S8



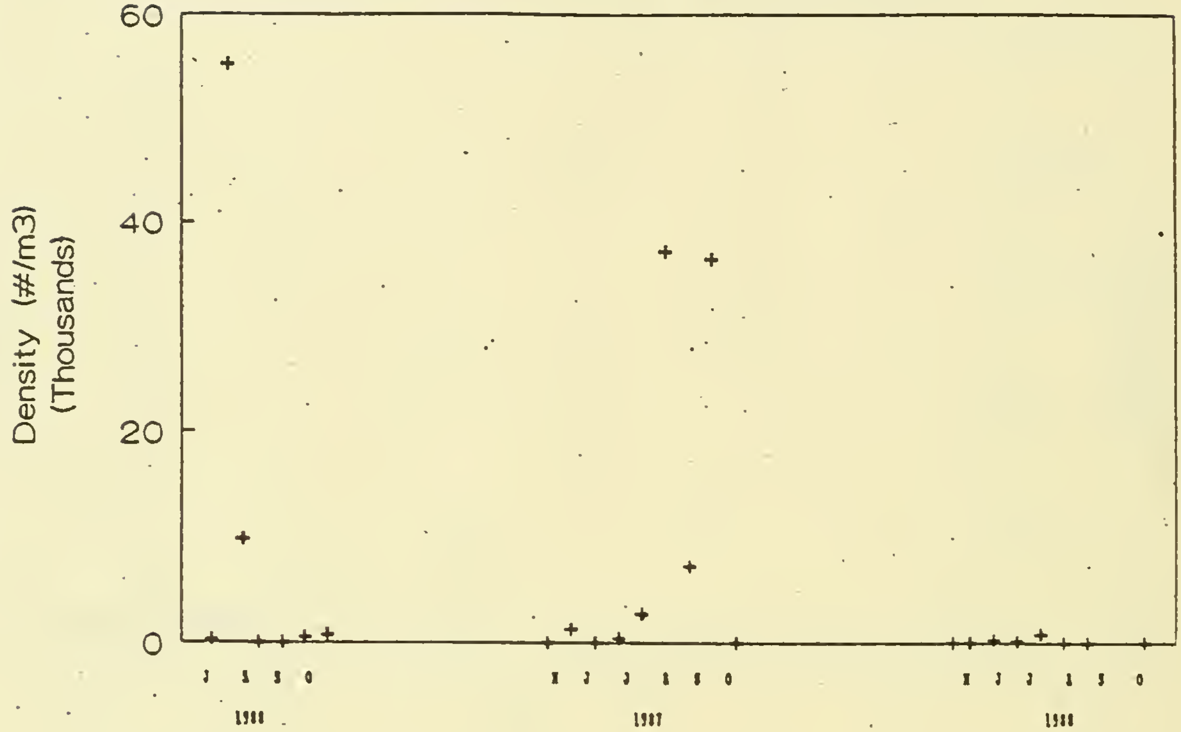
Density of Daphnia galeata mendotae
Sturgeon Lake - Station S8



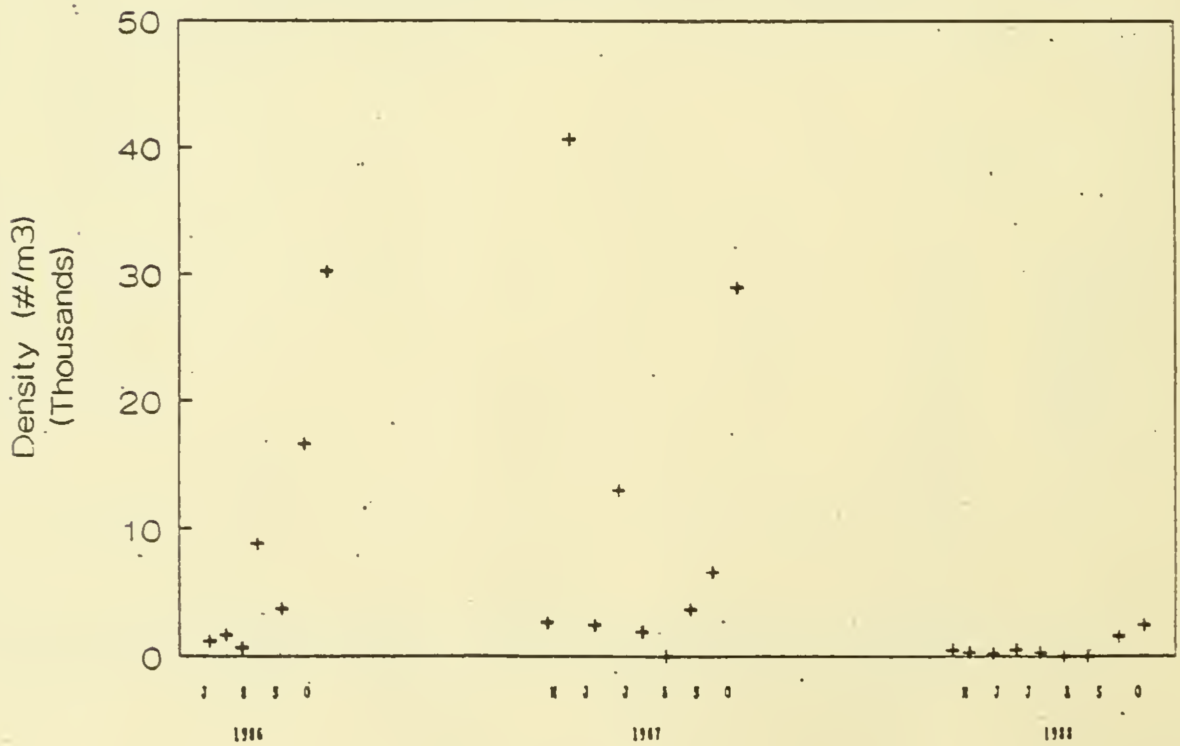
Density of Daphnia pulex
Sturgeon Lake - Station S8



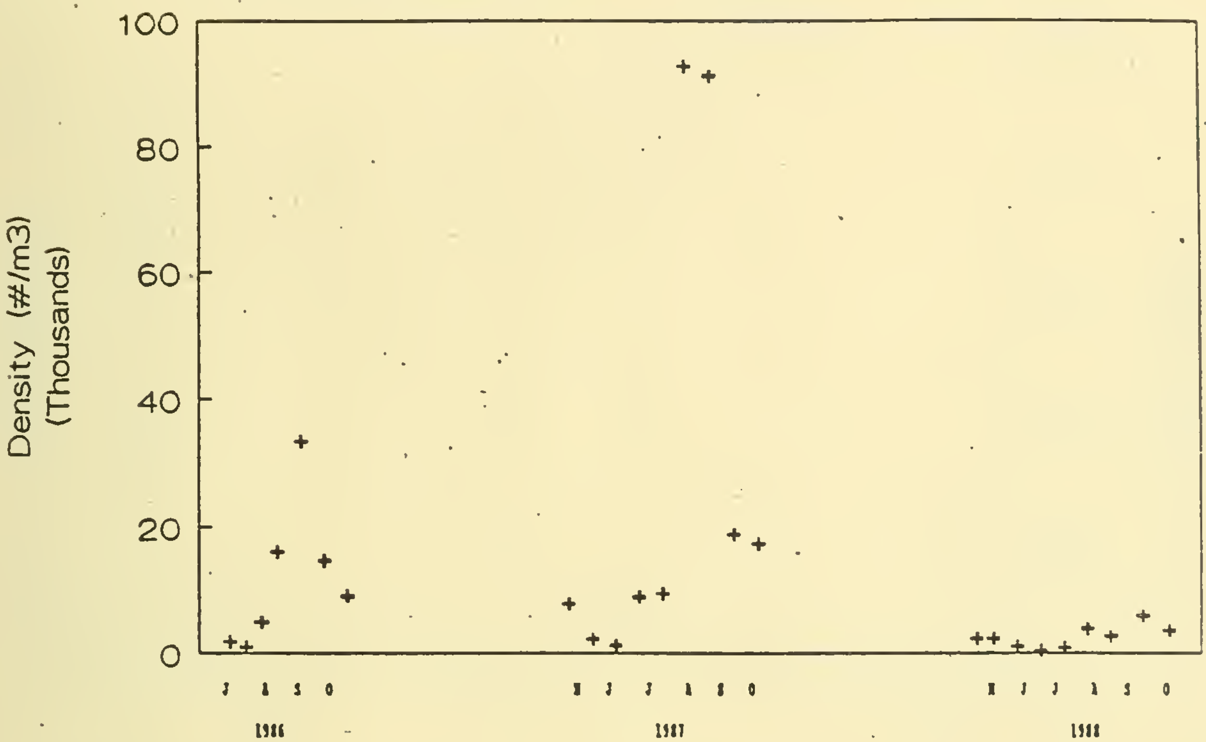
Density of Eubosmina coregoni
Sturgeon Lake - Station S8



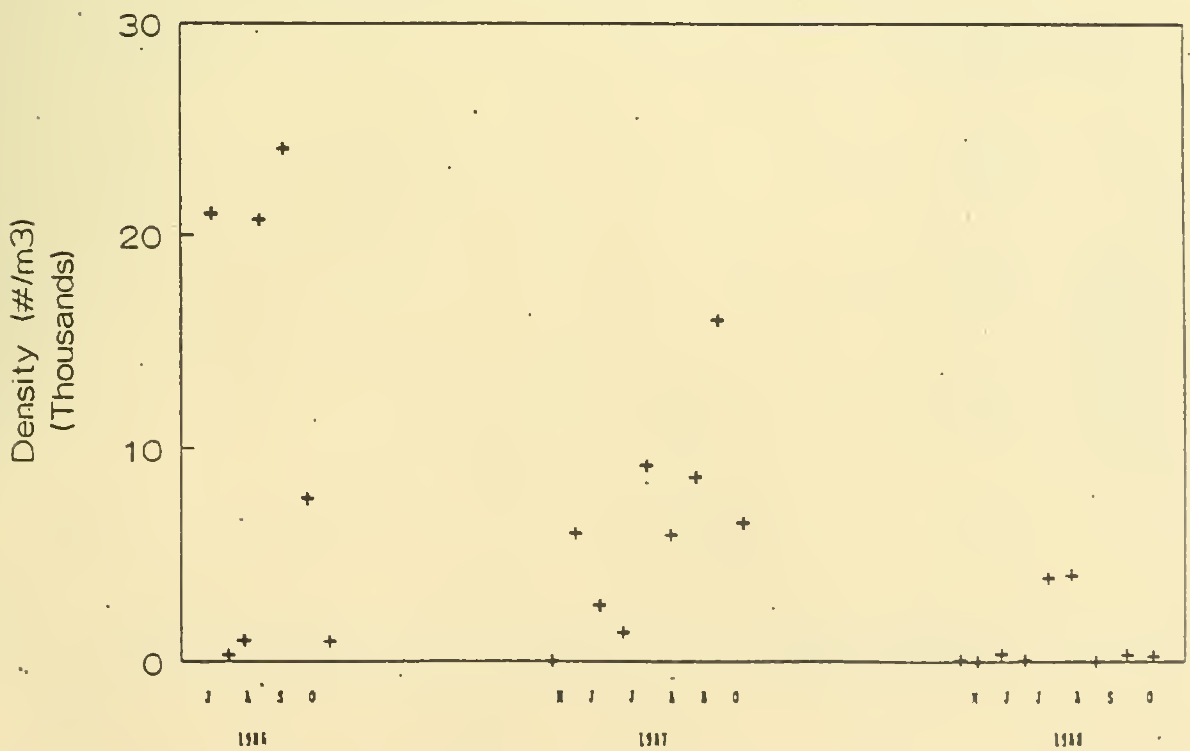
Density of Bosmina longirostris
Sturgeon Lake - Station S9



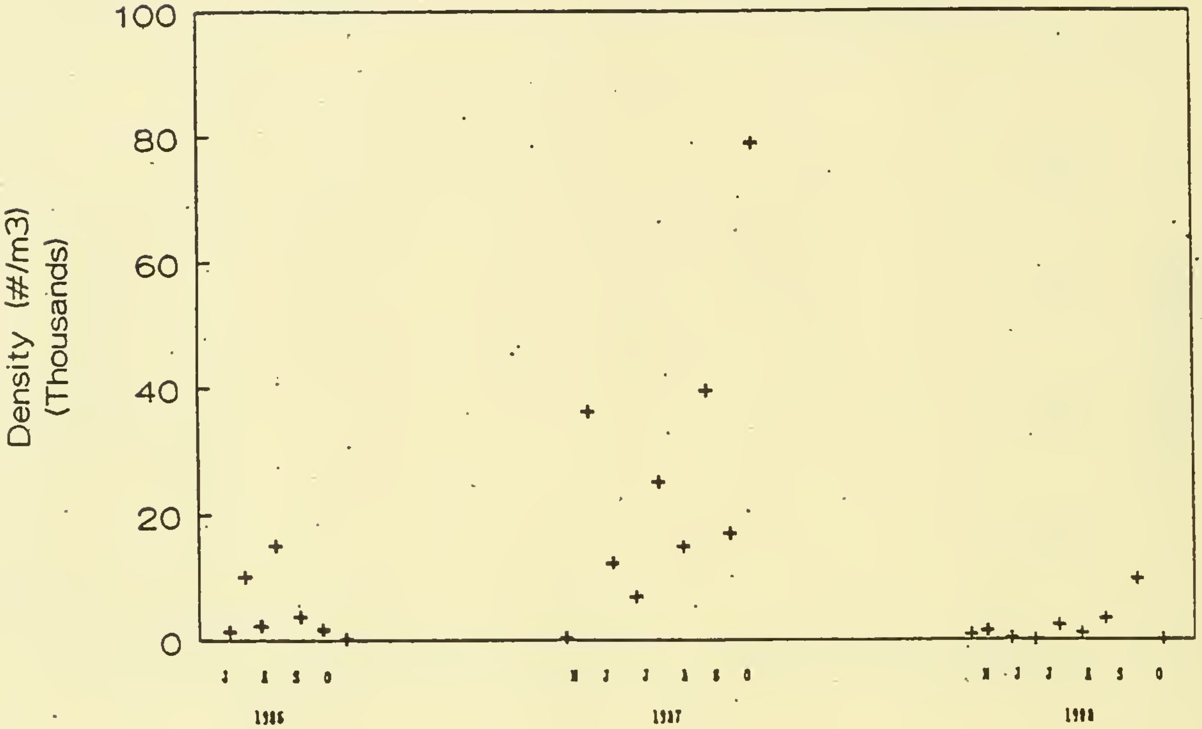
Density of Chydorus sphaericus
Sturgeon Lake - Station S9



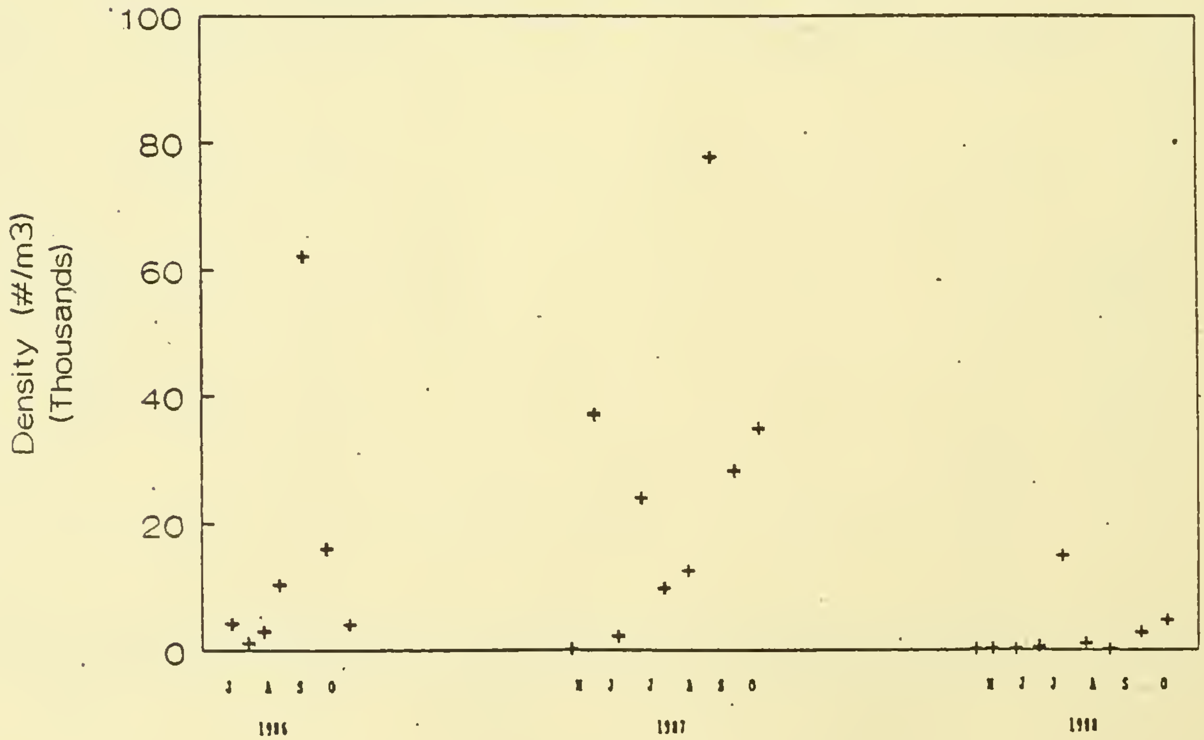
Density of Daphnia galeata mendotae
Sturgeon Lake - Station S9



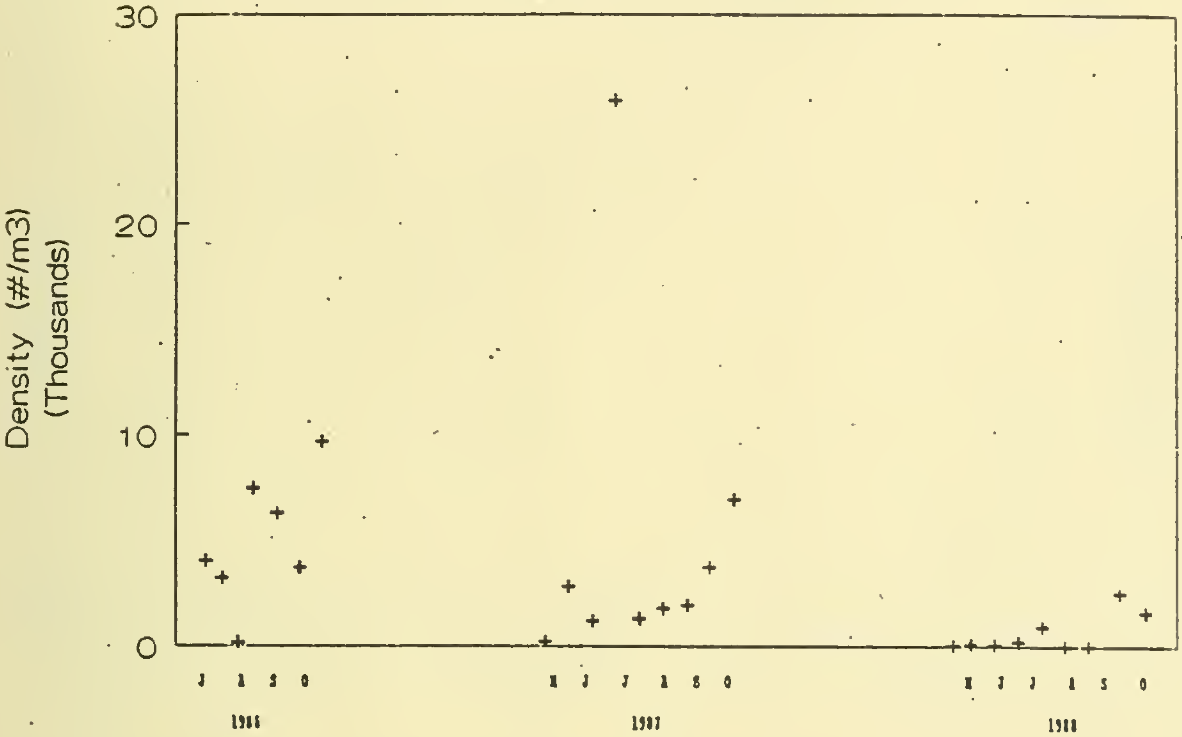
Density of Daphnia pulex
Sturgeon Lake - Station S9



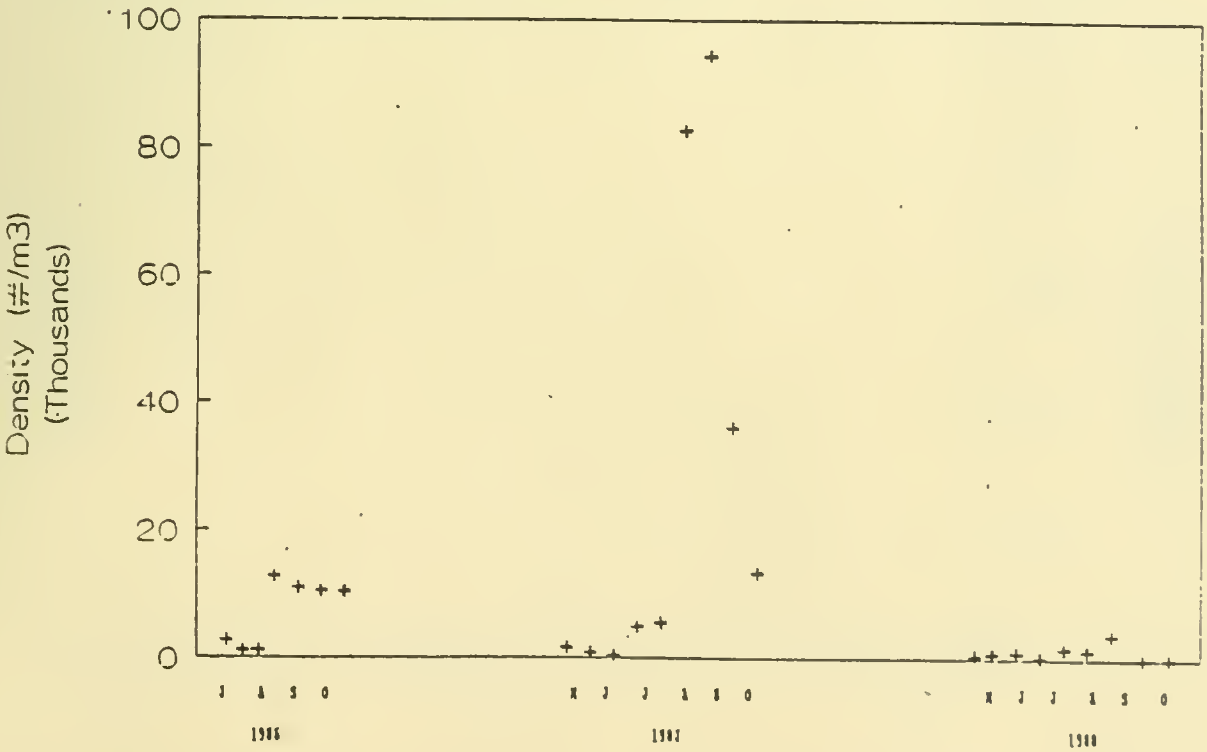
Density of Eubosmina coregoni
Sturgeon Lake - Station S9



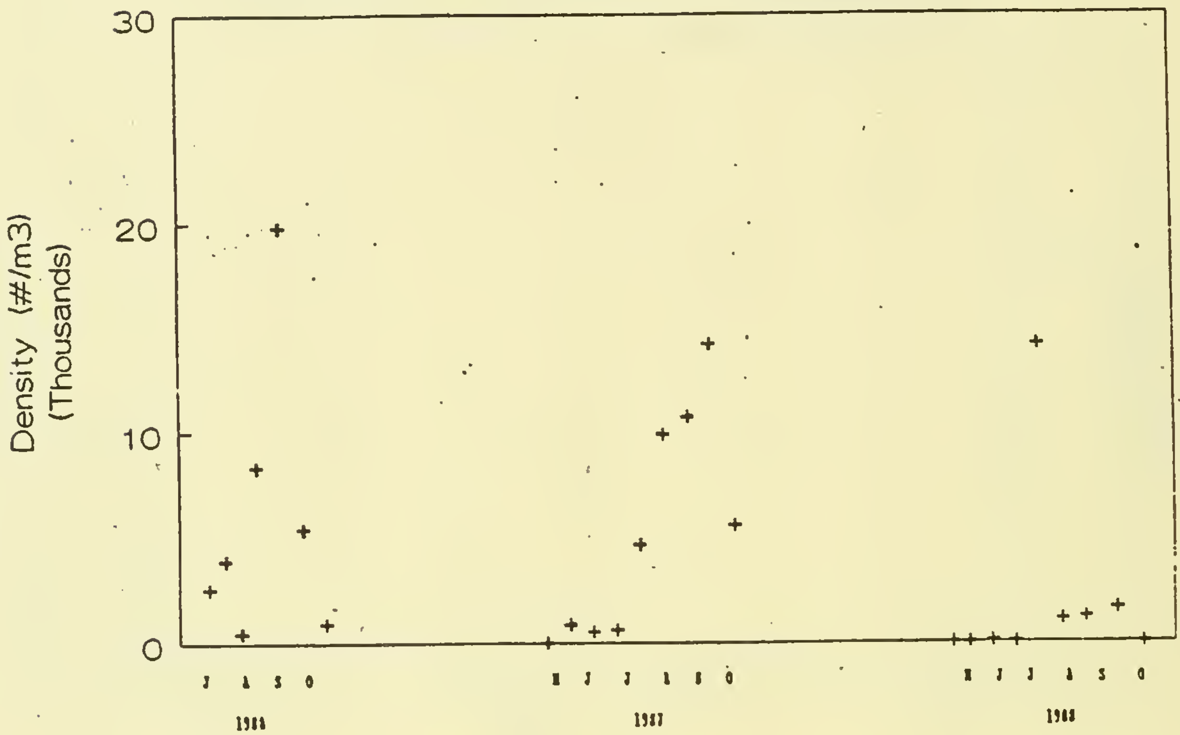
Density of Bosmina longirostris
Sturgeon Lake - Station S10



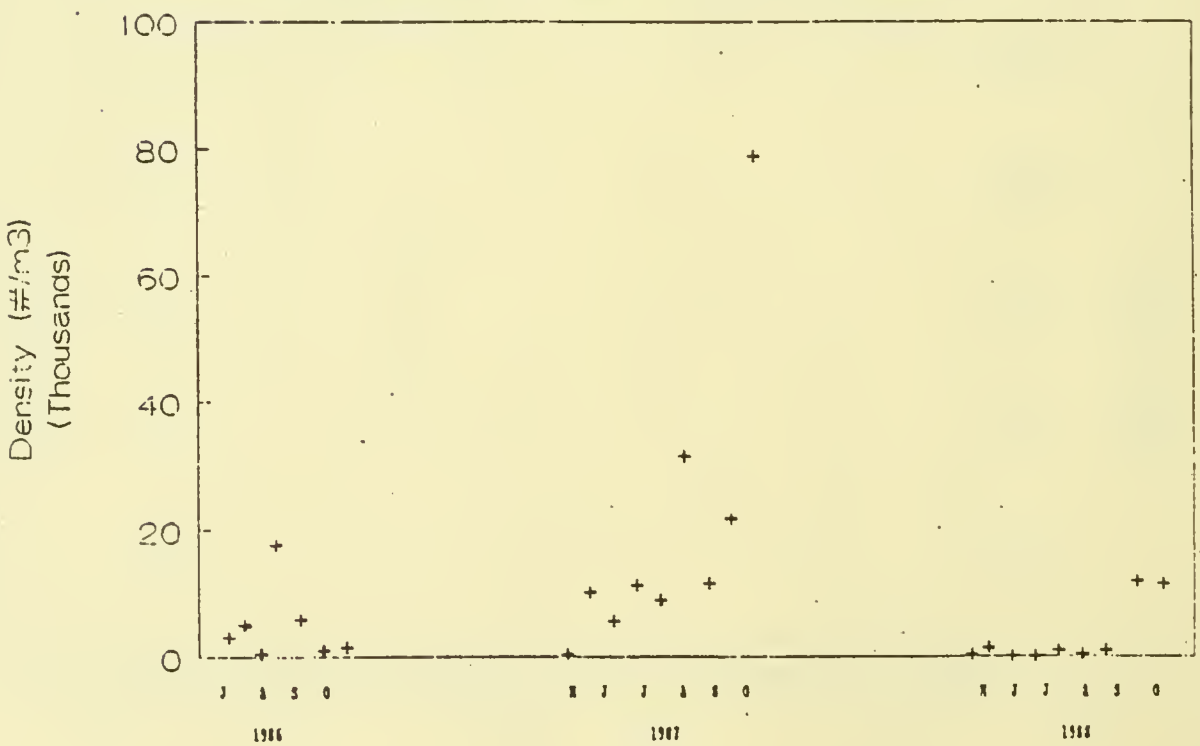
Density of Chydorus sphaericus
Sturgeon Lake - Station S10



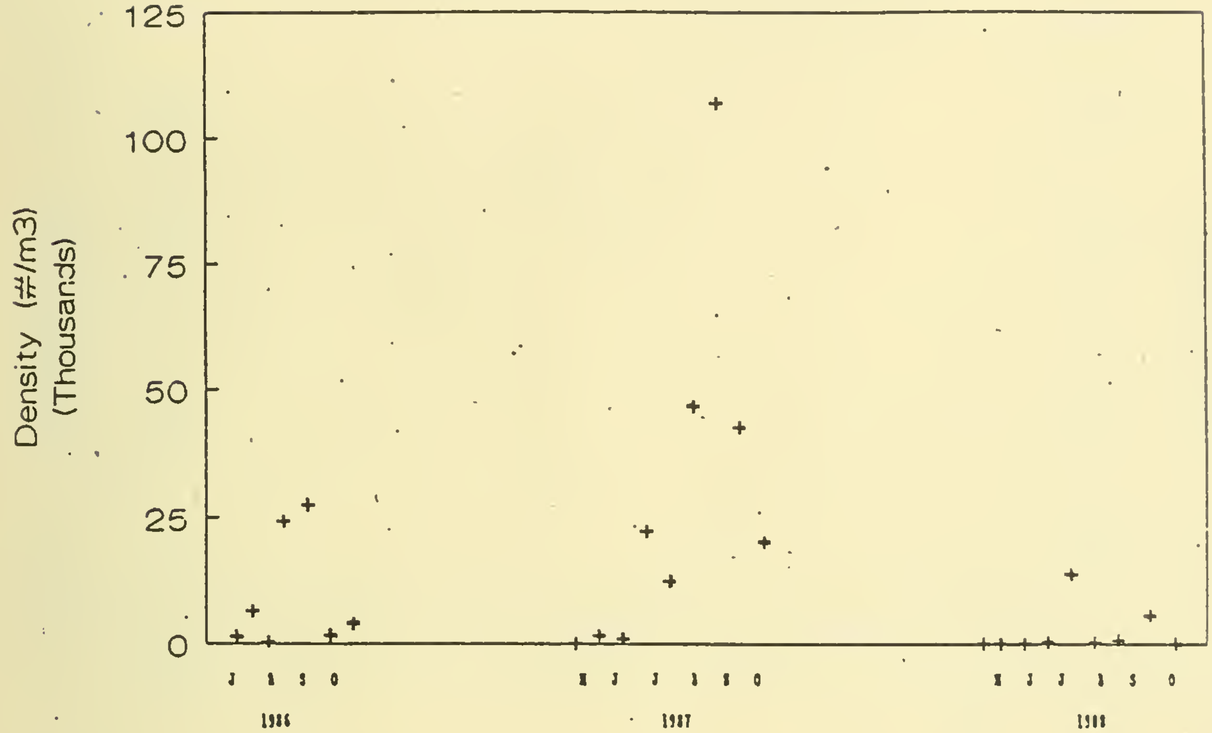
Density of Daphnia galeata mendotae
Sturgeon Lake - Station S10



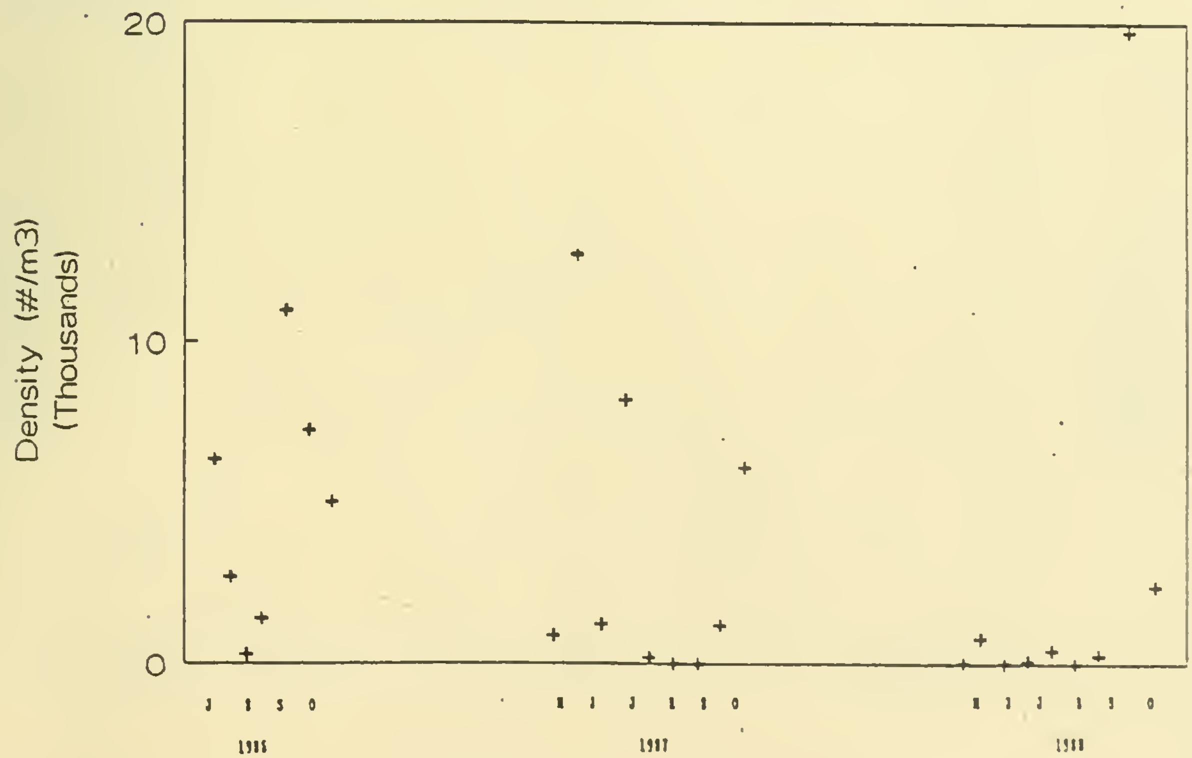
Density of Daphnia pulex
Sturgeon Lake - Station S10



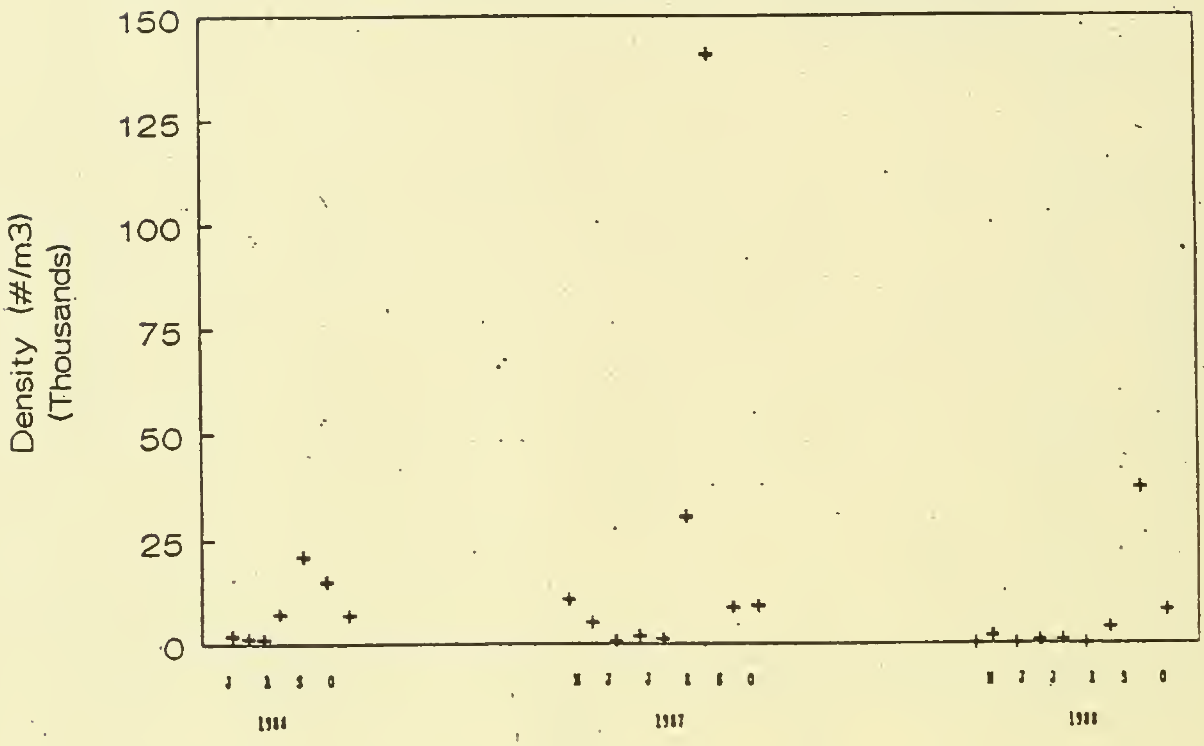
Density of Eubosmina coregoni
Sturgeon Lake - Station S10



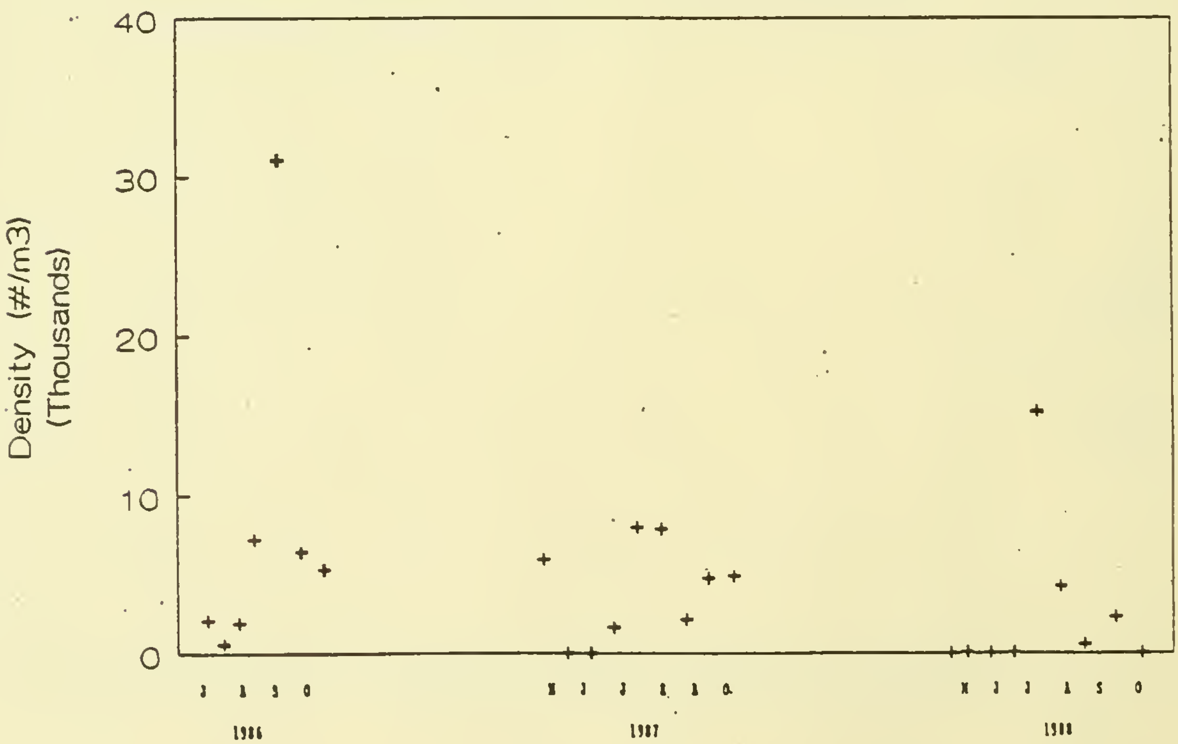
Density of Bosmina longirostris
Sturgeon Lake - Station S11



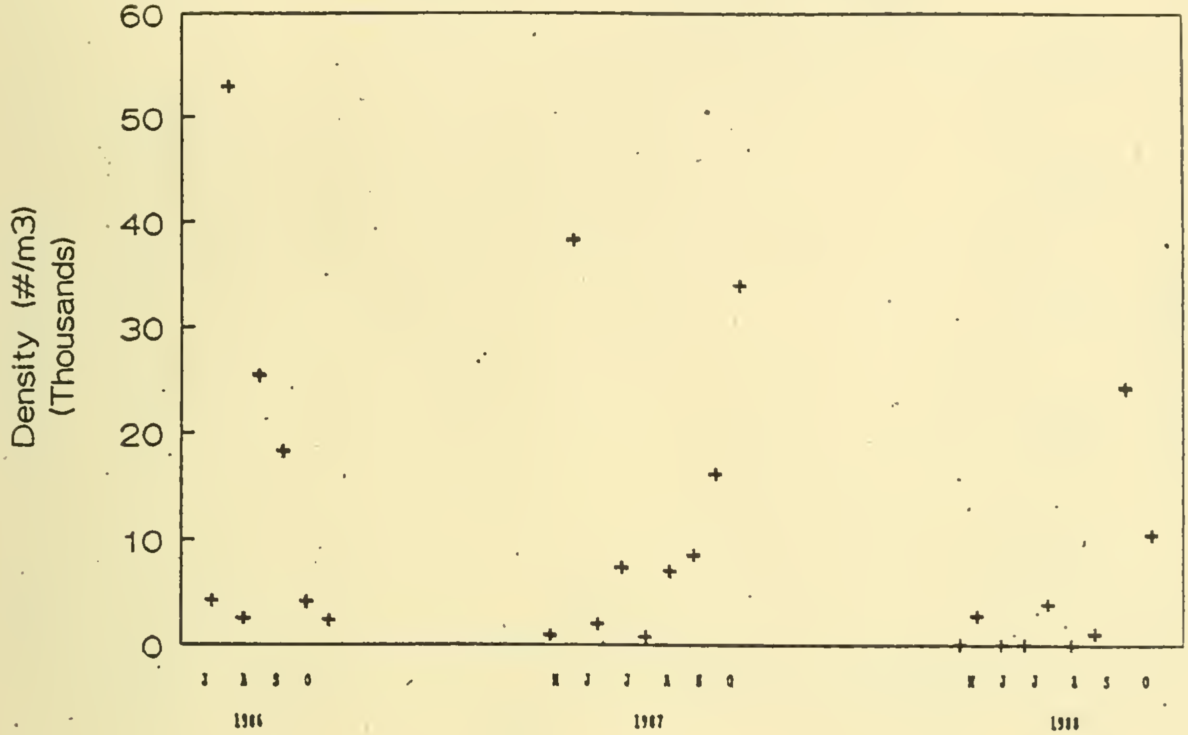
Density of Chydorus sphaericus
Sturgeon Lake - Station S11



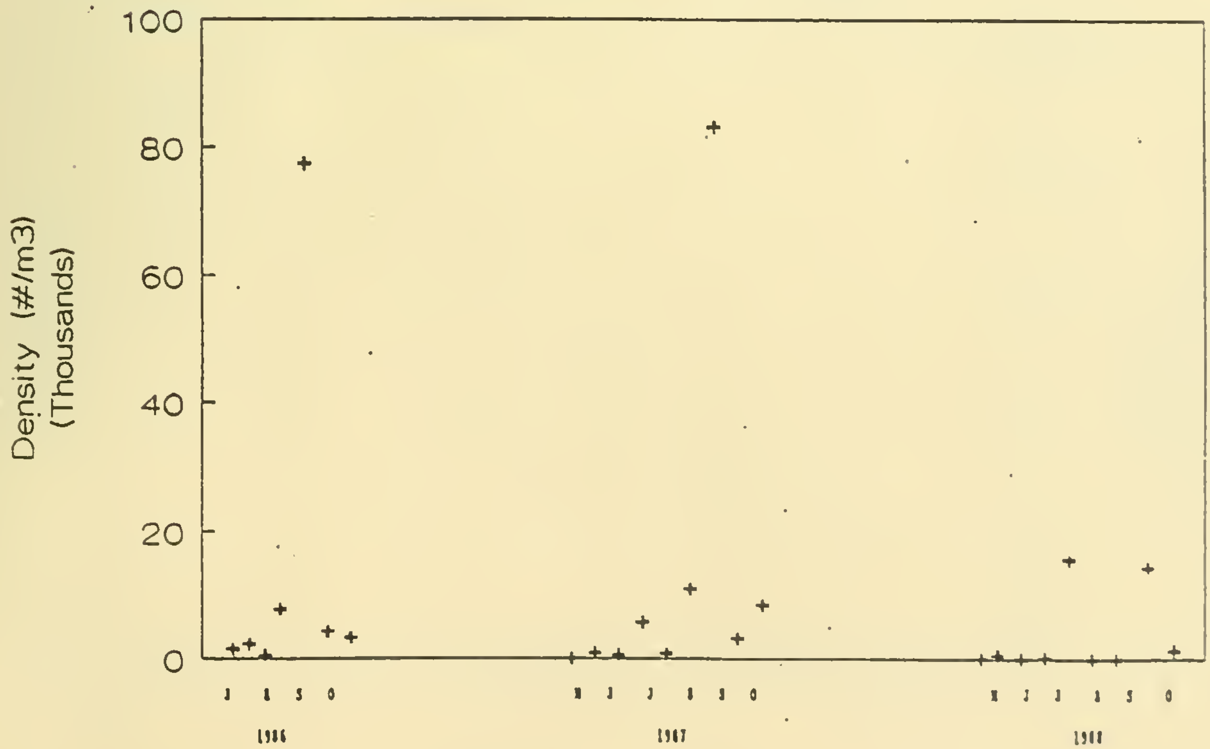
Density of Daphnia galeata mendotae
Sturgeon Lake - Station S11



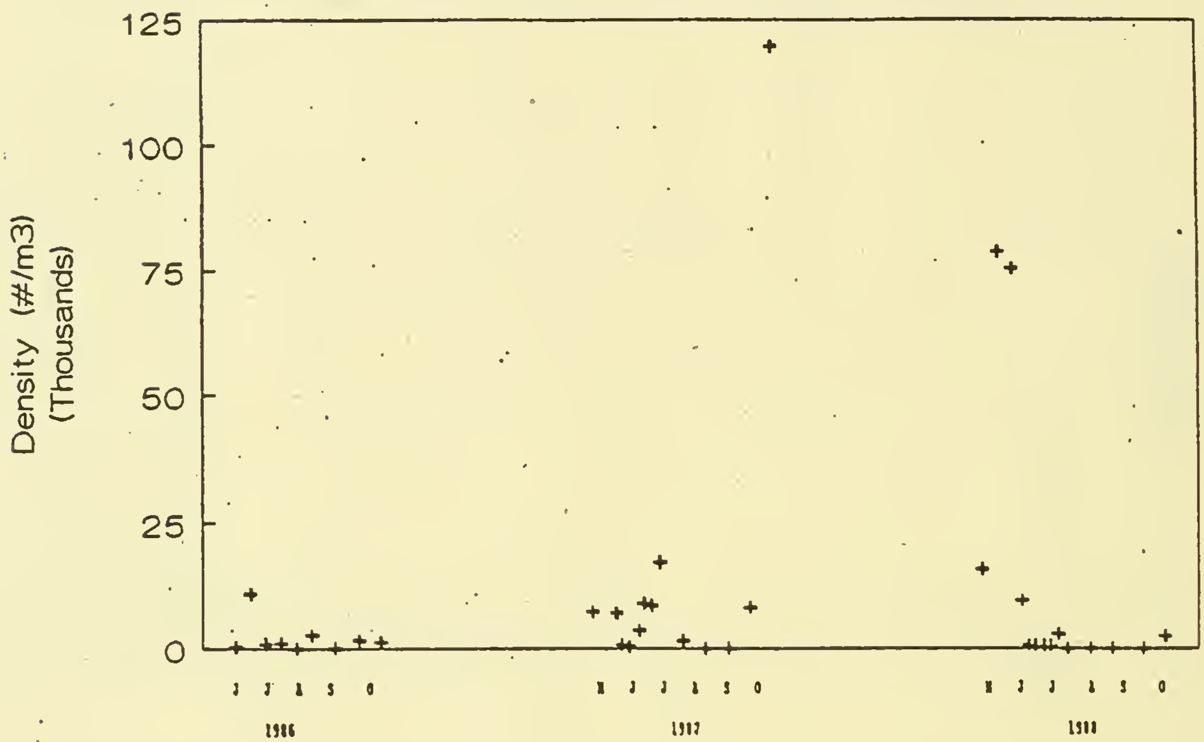
Density of Daphnia pulex
Sturgeon Lake - Station S11



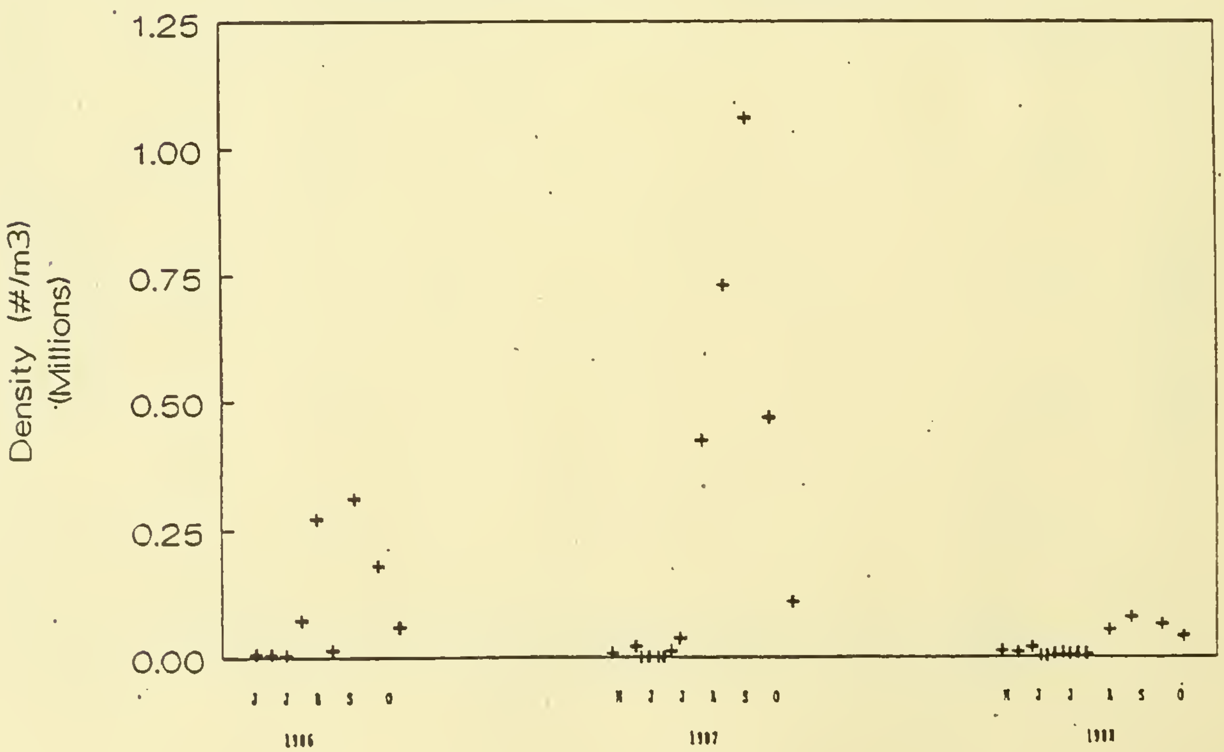
Density of Eubosmina coregoni
Sturgeon Lake - Station S11



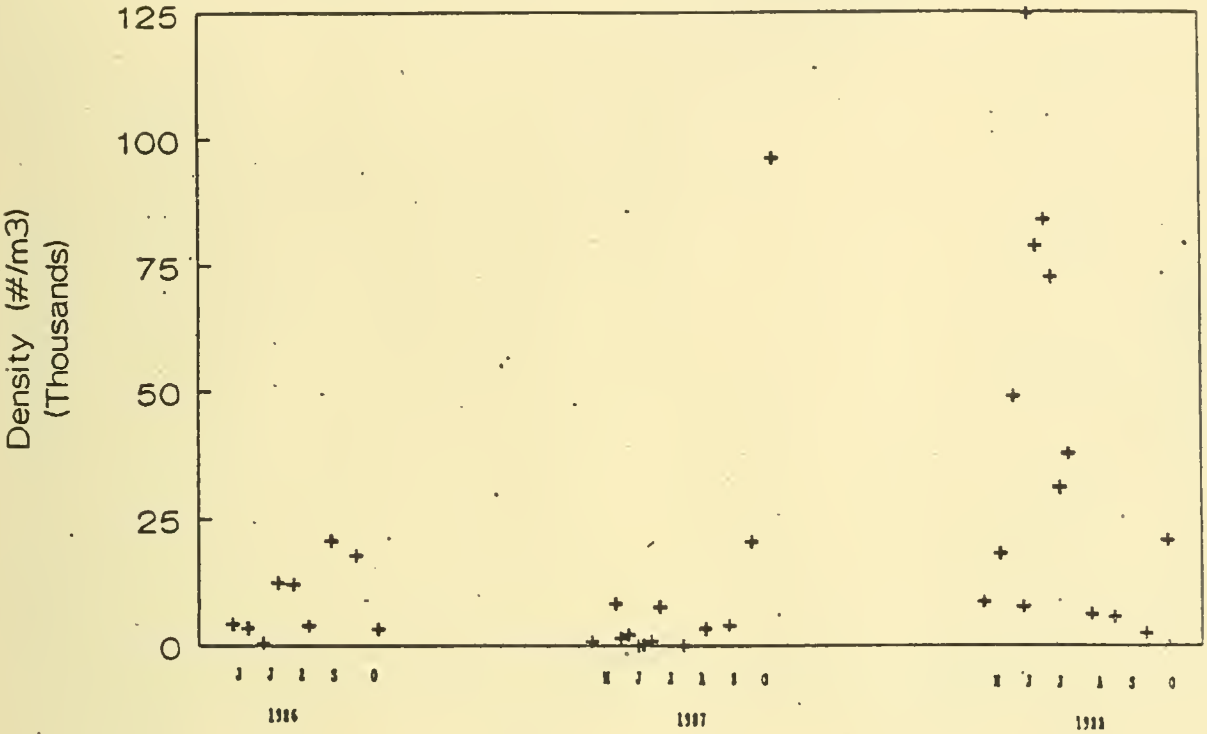
Density of Bosmina longirostris
Rice Lake - Station R33



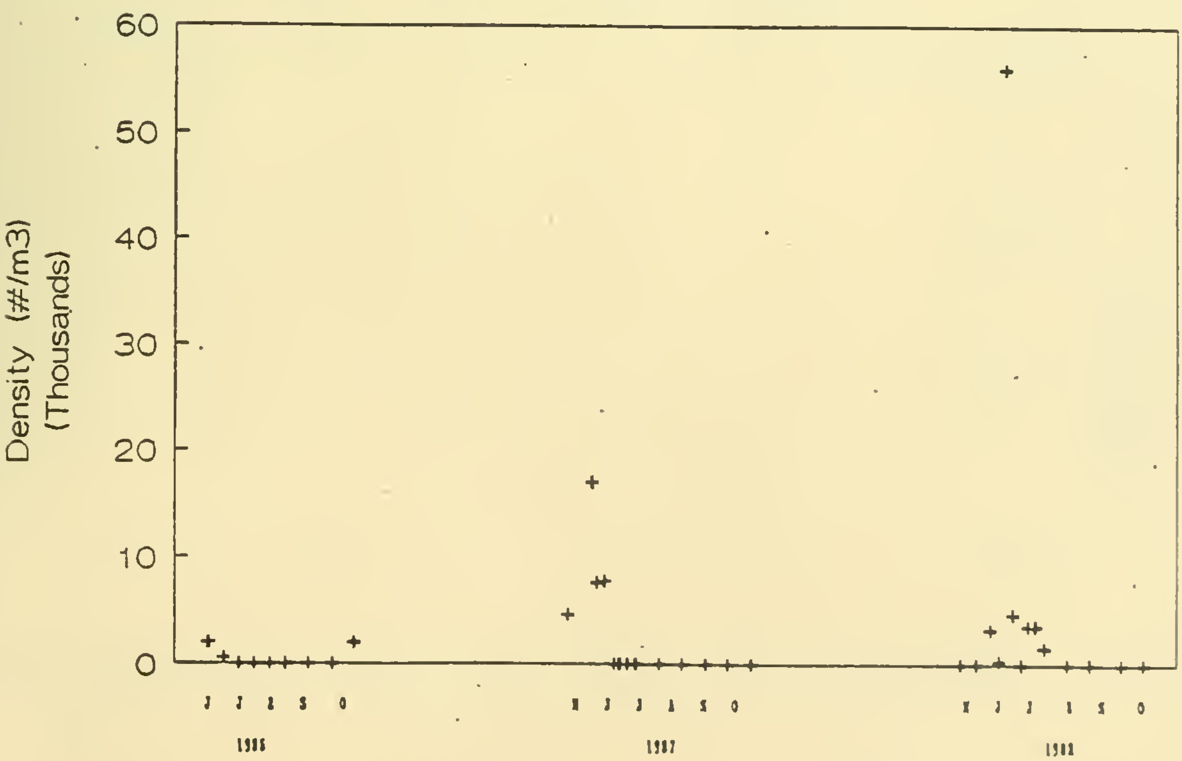
Density of Chydorus sphaericus
Rice Lake - Station R33



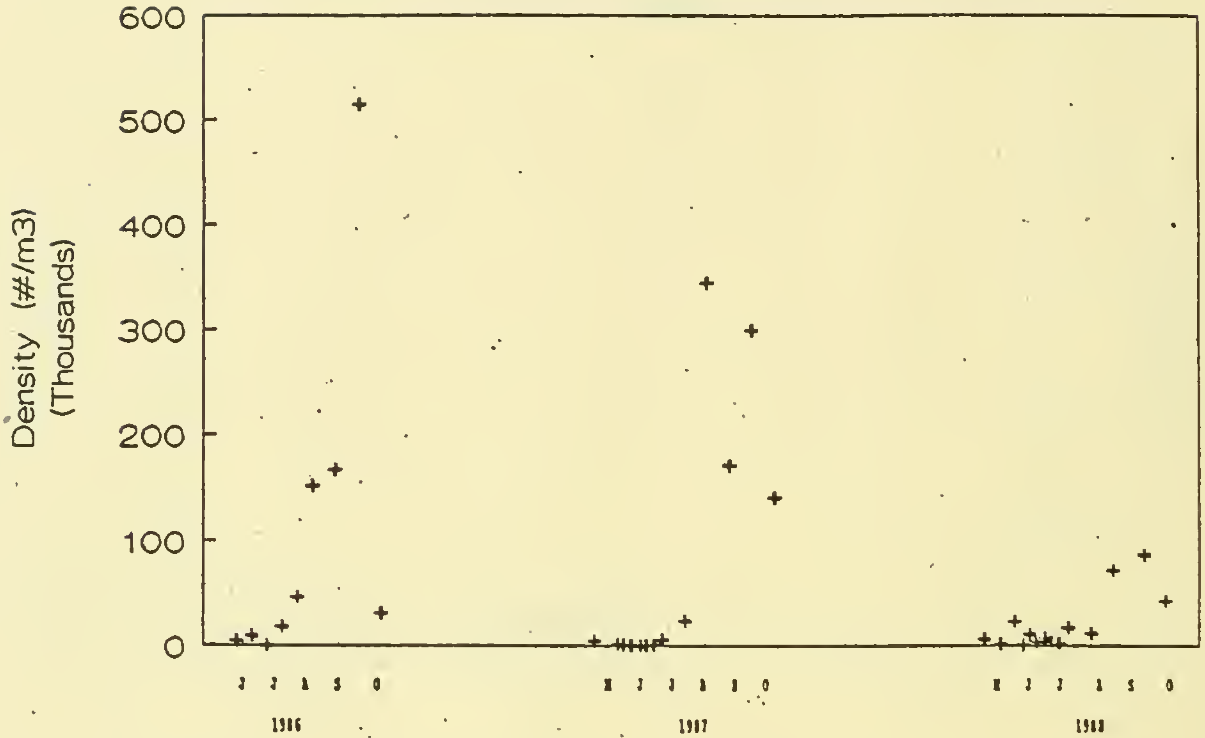
Density of Daphnia galeata mendotae
Rice Lake - Station R33



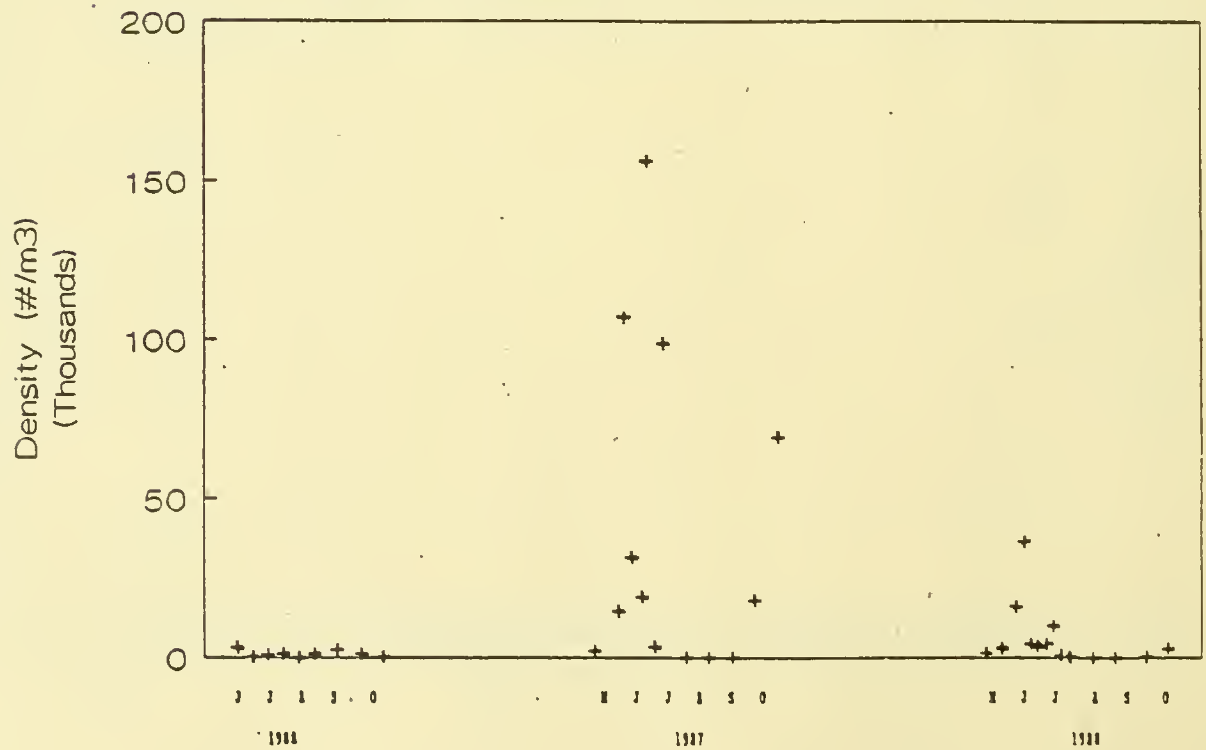
Density of Daphnia pulex
Rice Lake - Station R33



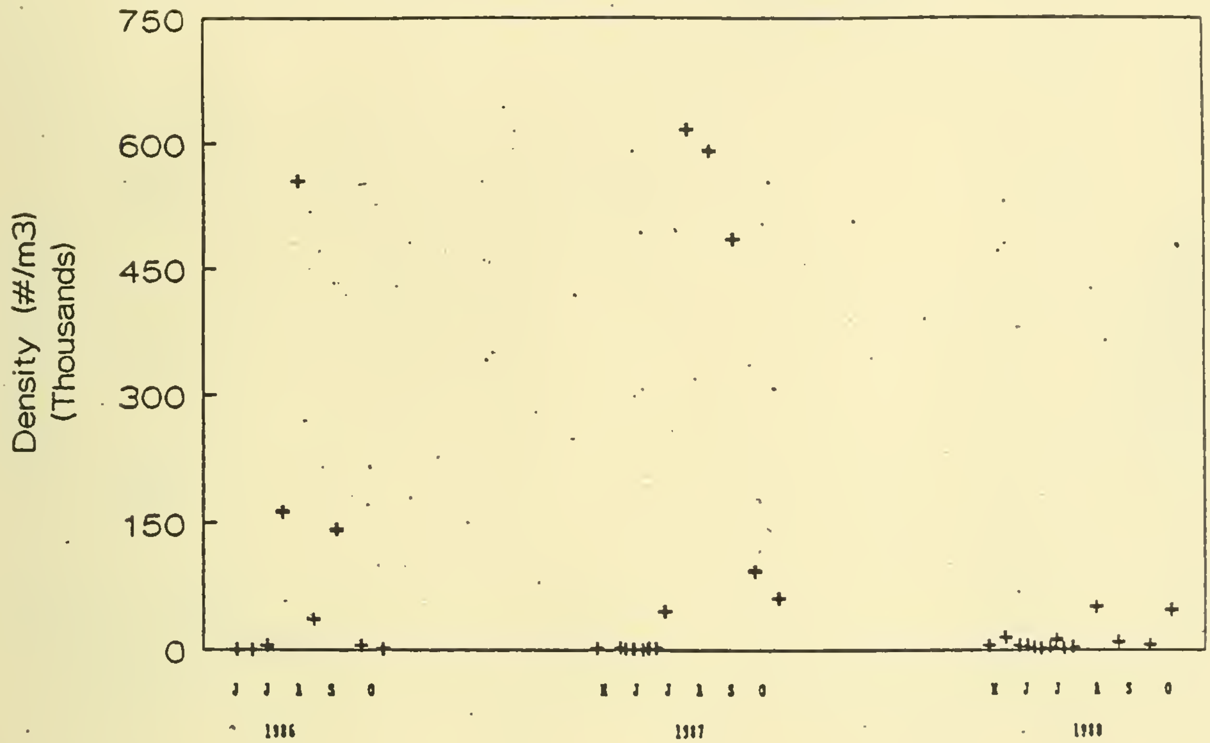
Density of Eubosmina coregoni
Rice Lake - Station R33



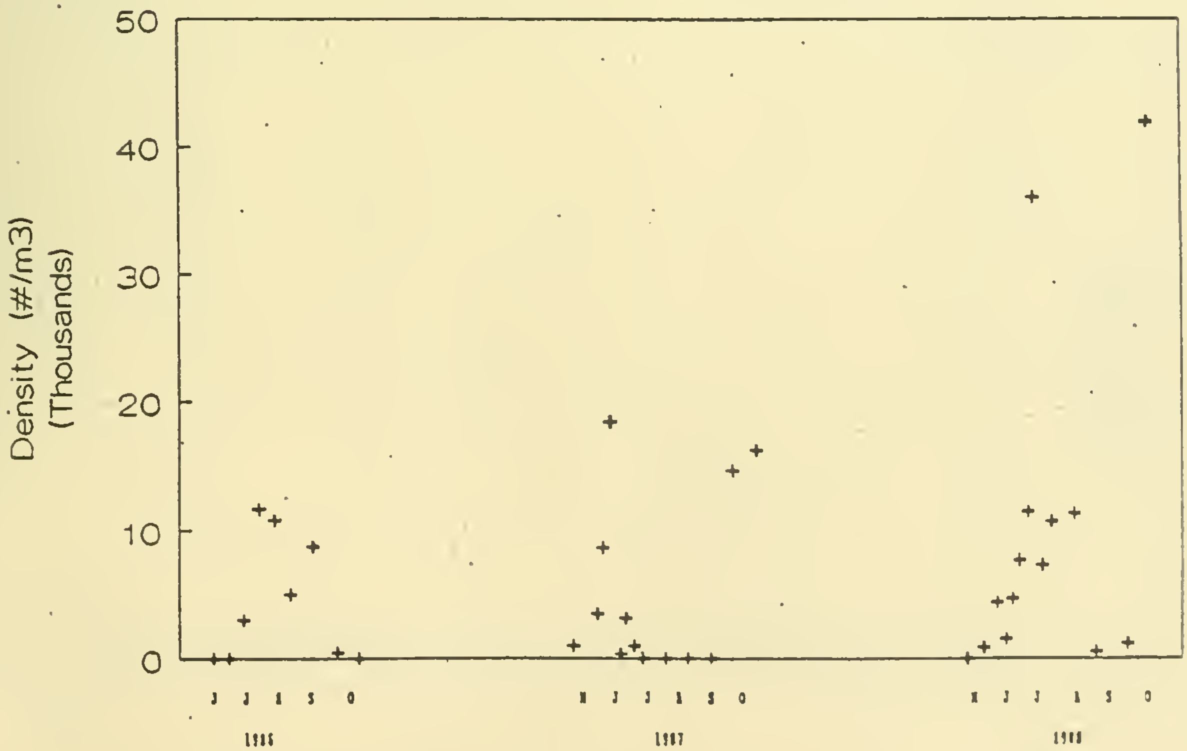
Density of Bosmina longirostris
Rice Lake - Station R34



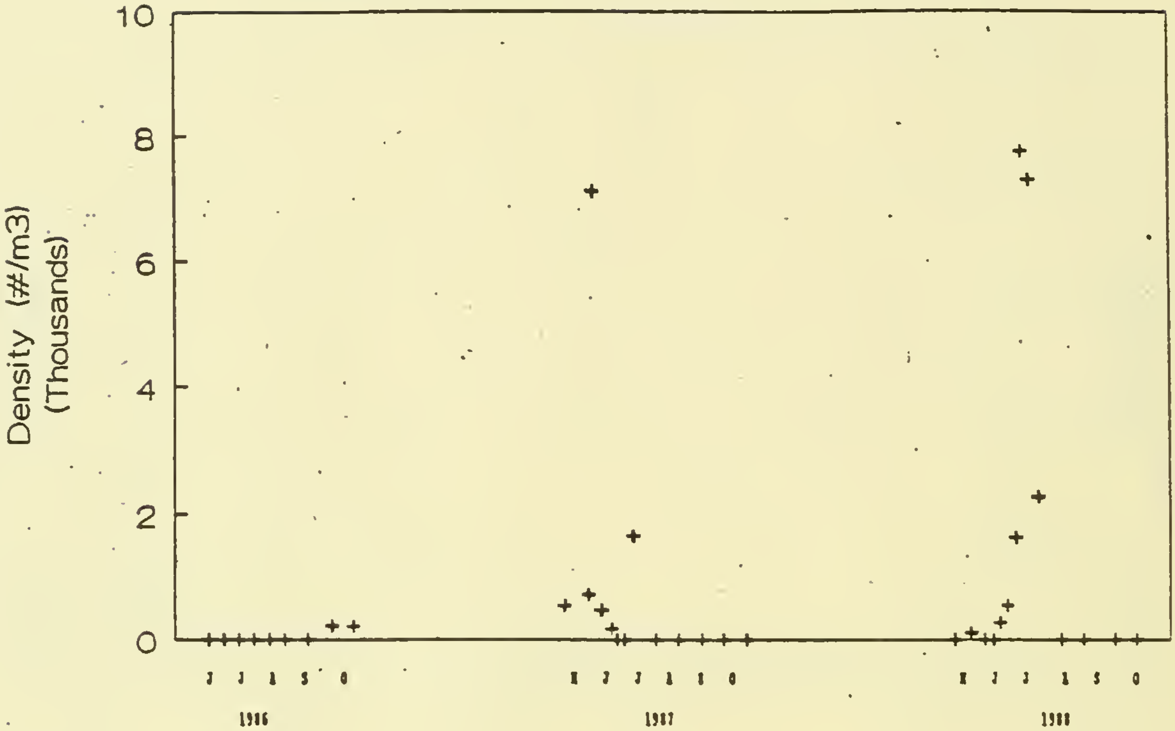
Density of Chydorus sphaericus
Rice Lake - Station R34



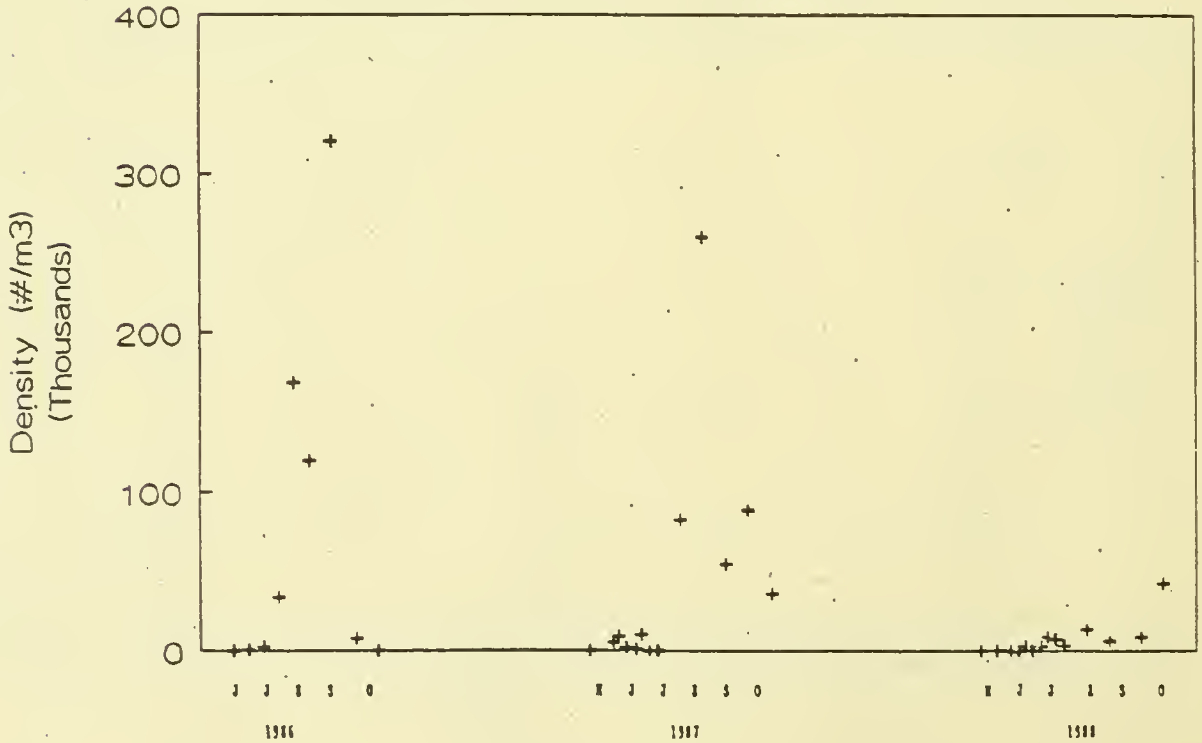
Density of Daphnia galeata mendotae
Rice Lake - Station R34



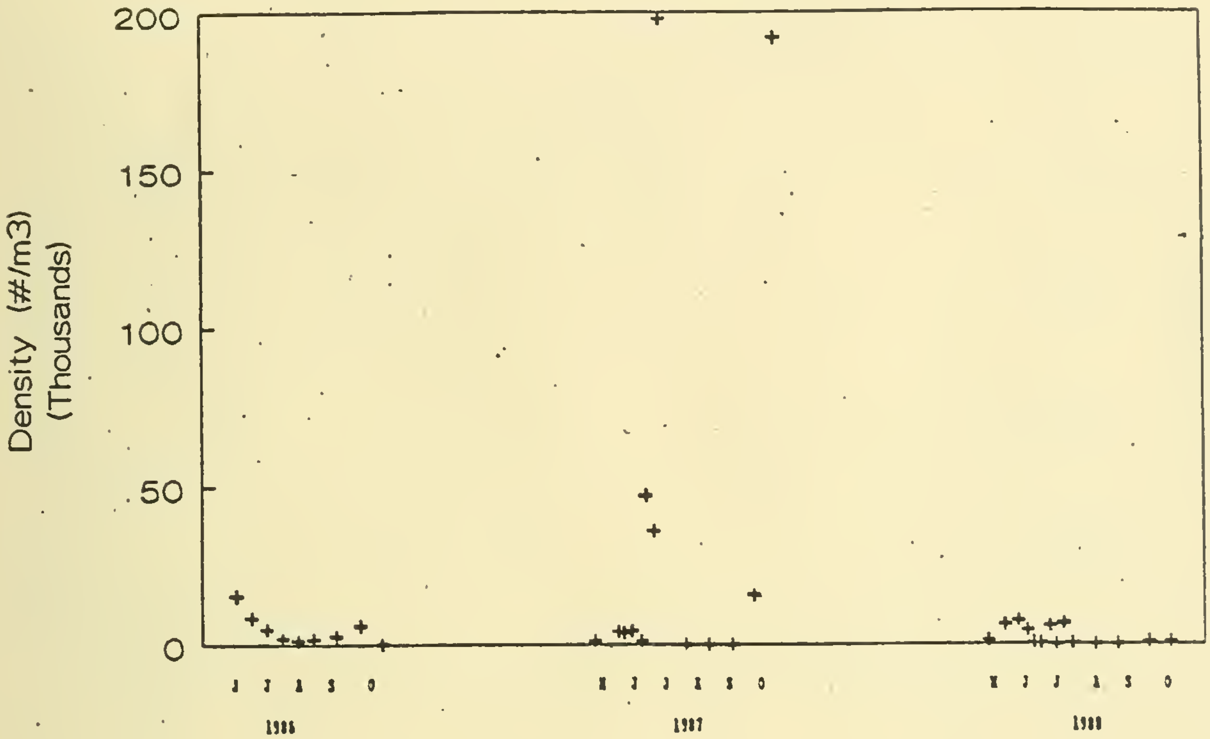
Density of Daphnia pulex
Rice Lake - Station R34



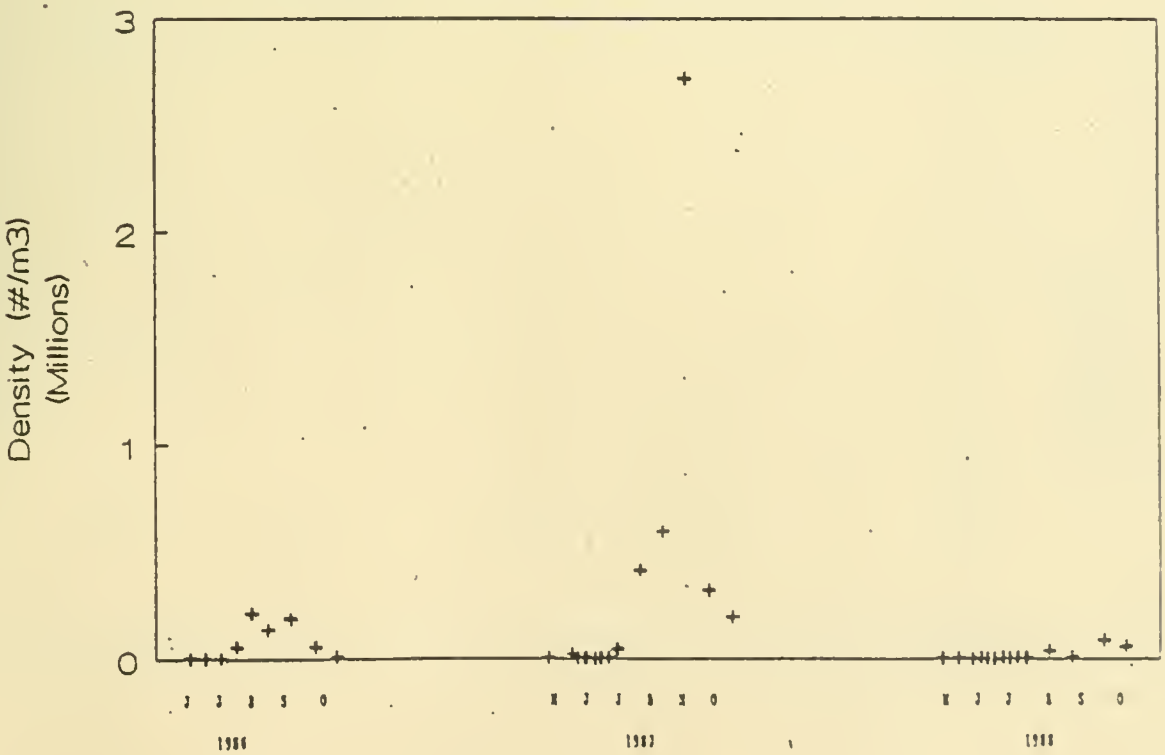
Density of Eubosmina coregoni
Rice Lake - Station R34



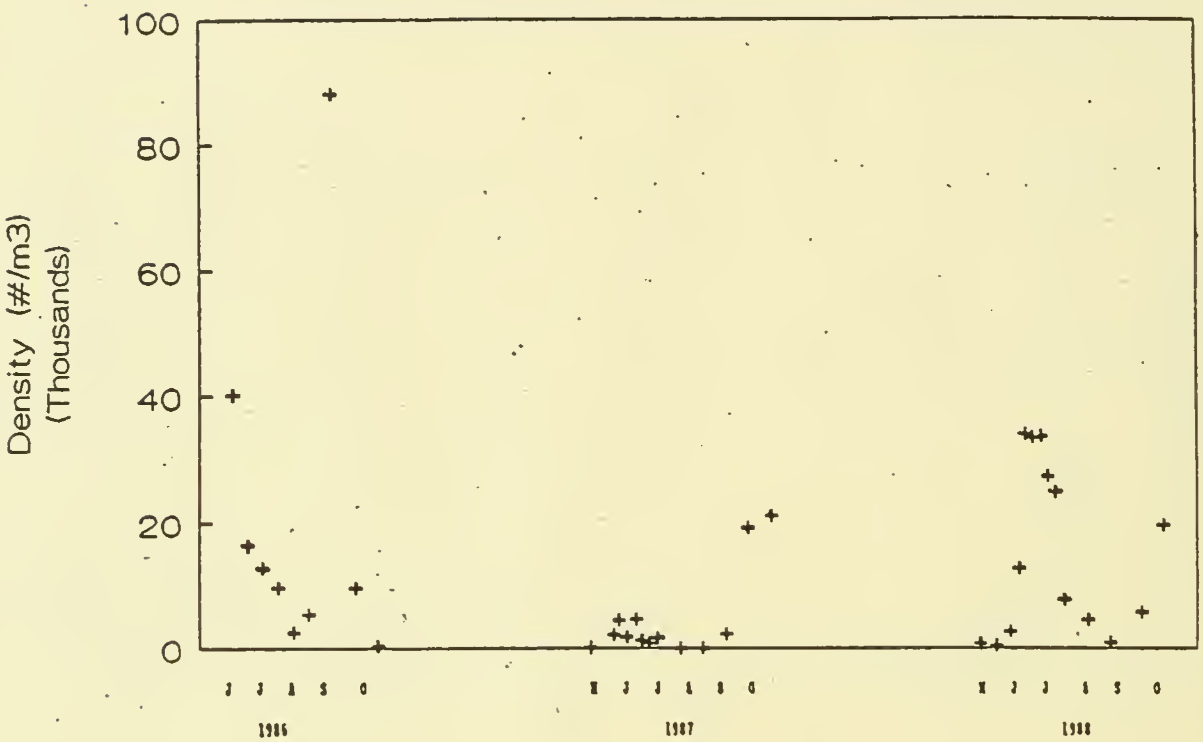
Density of Bosmina longirostris
Rice Lake - Station R35



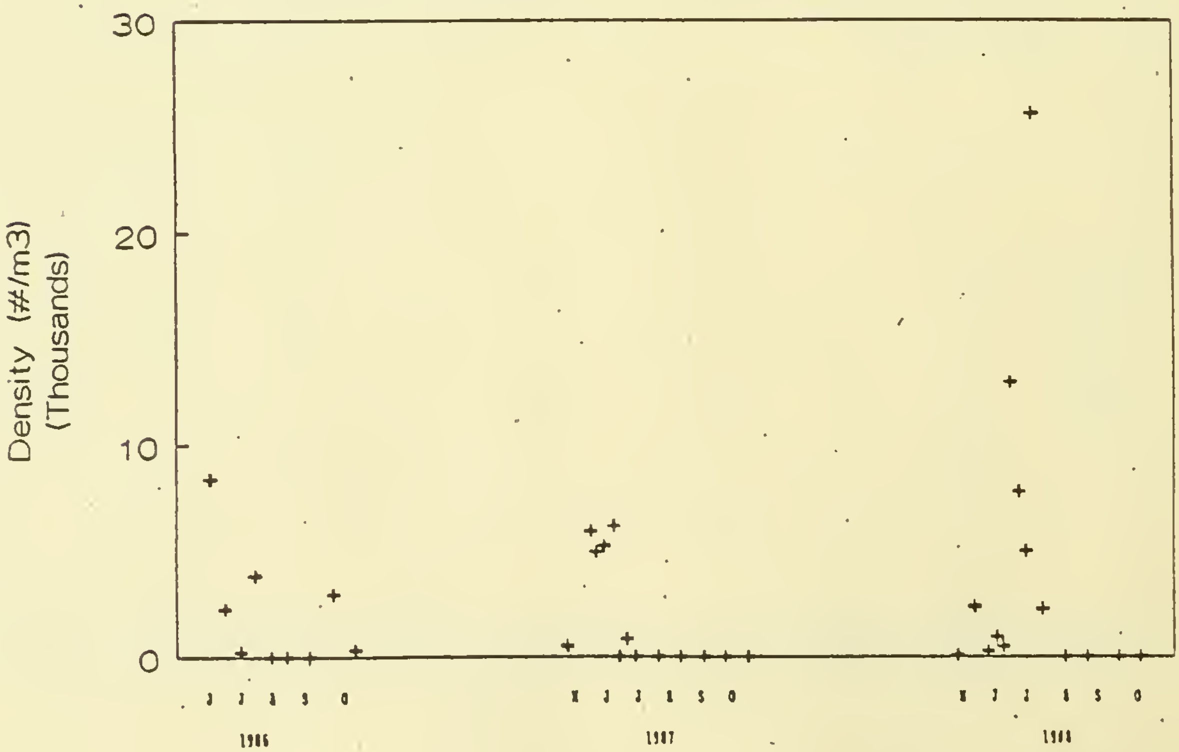
Density of Chydorus sphaericus
Rice Lake - Station R35



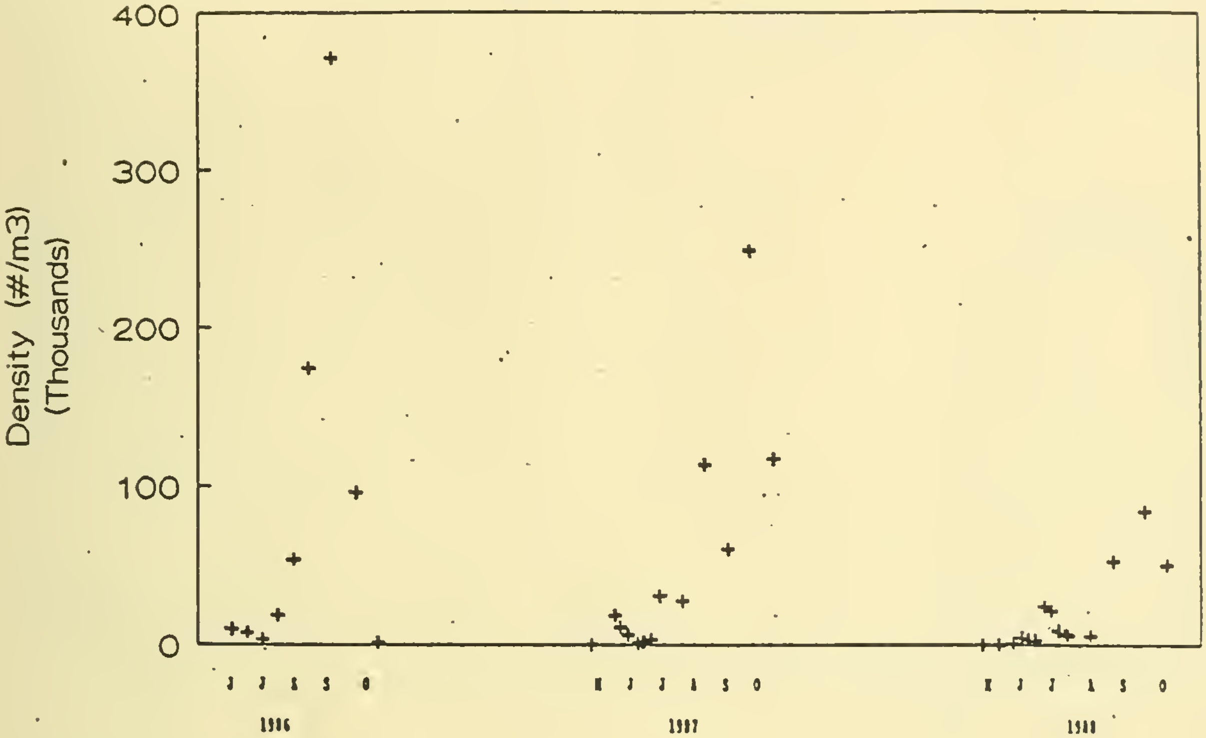
Density of Daphnia galeata mendotae
Rice Lake - Station R35



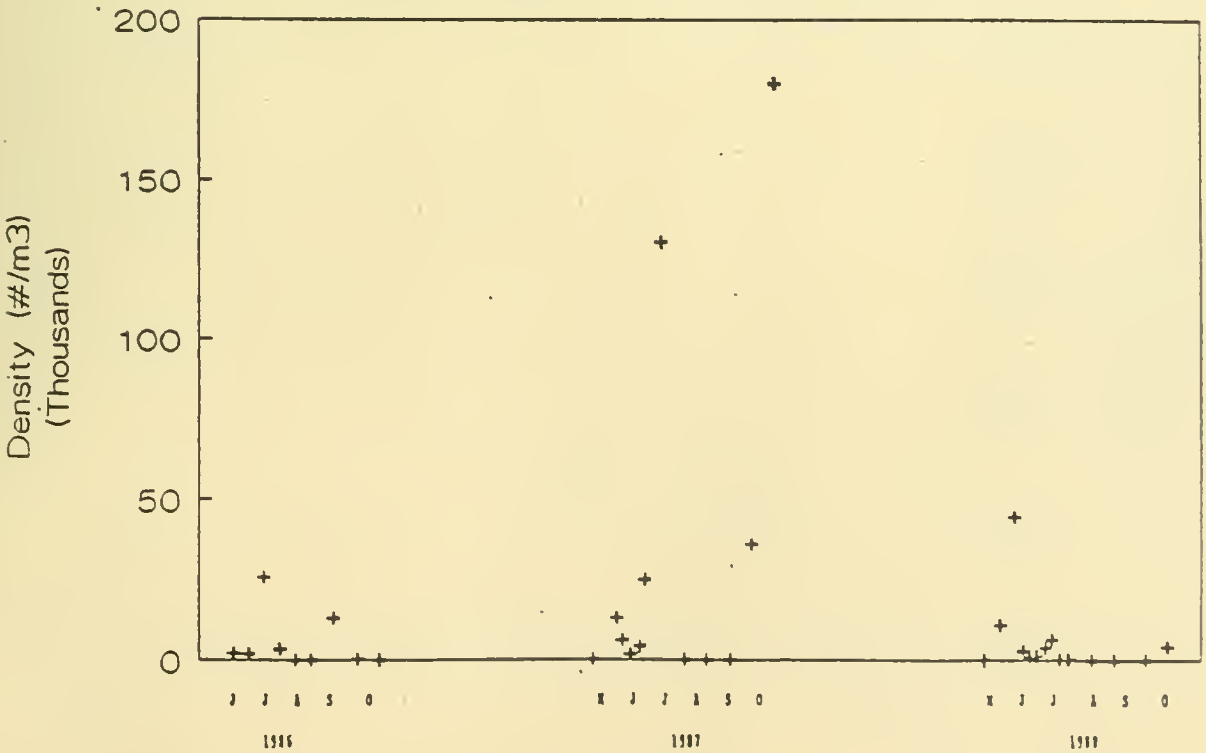
Density of Daphnia pulex
Rice Lake - Station R35



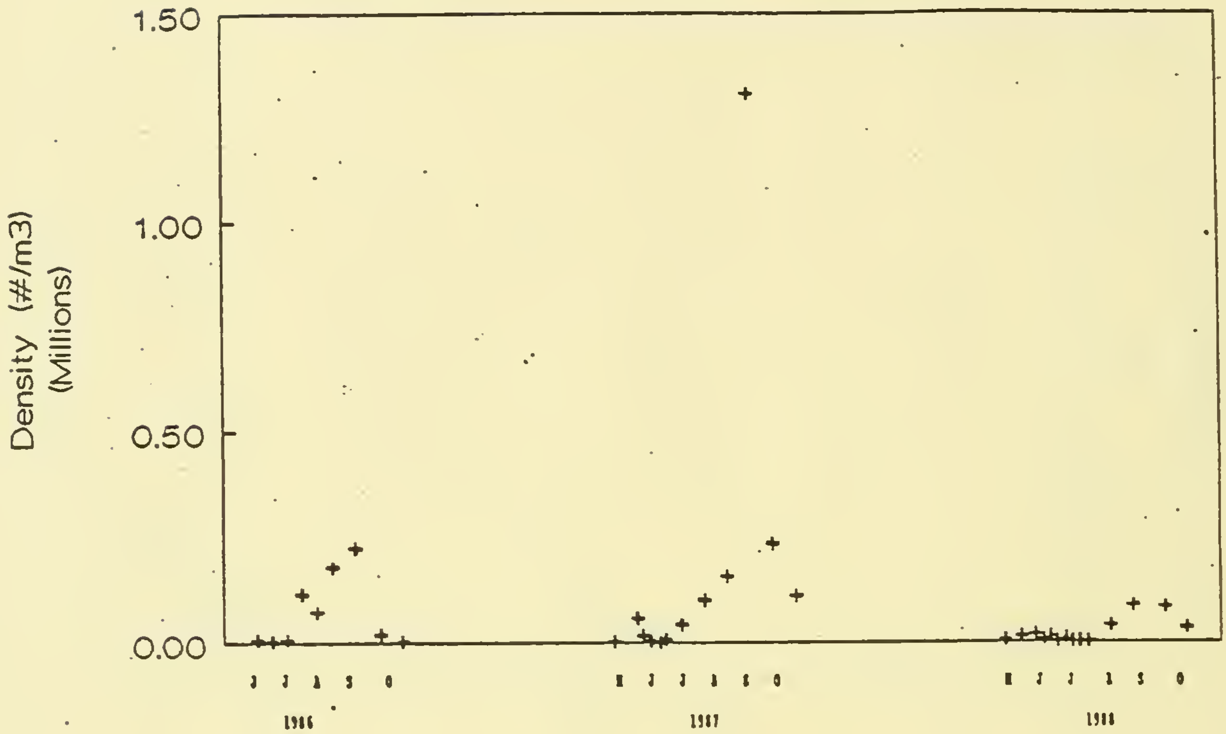
Density of Eubosmina coregoni
Rice Lake - Station R35



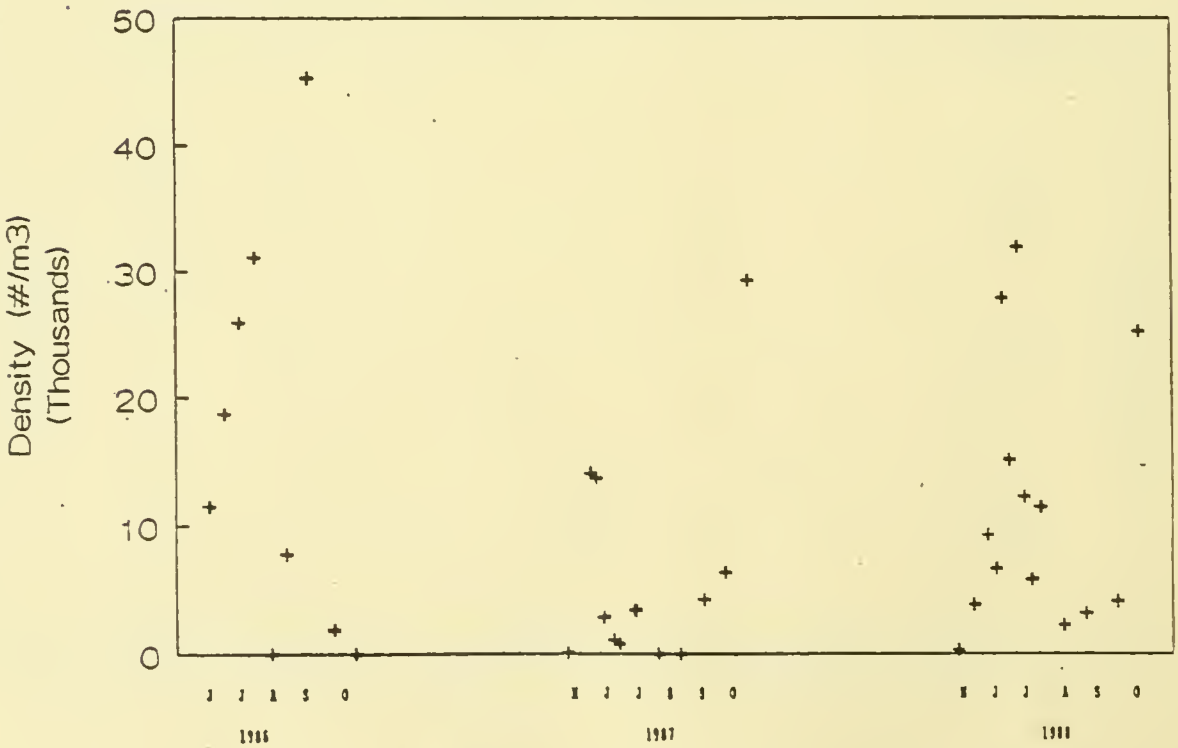
Density of Bosmina longirostris
Rice Lake - Station R36



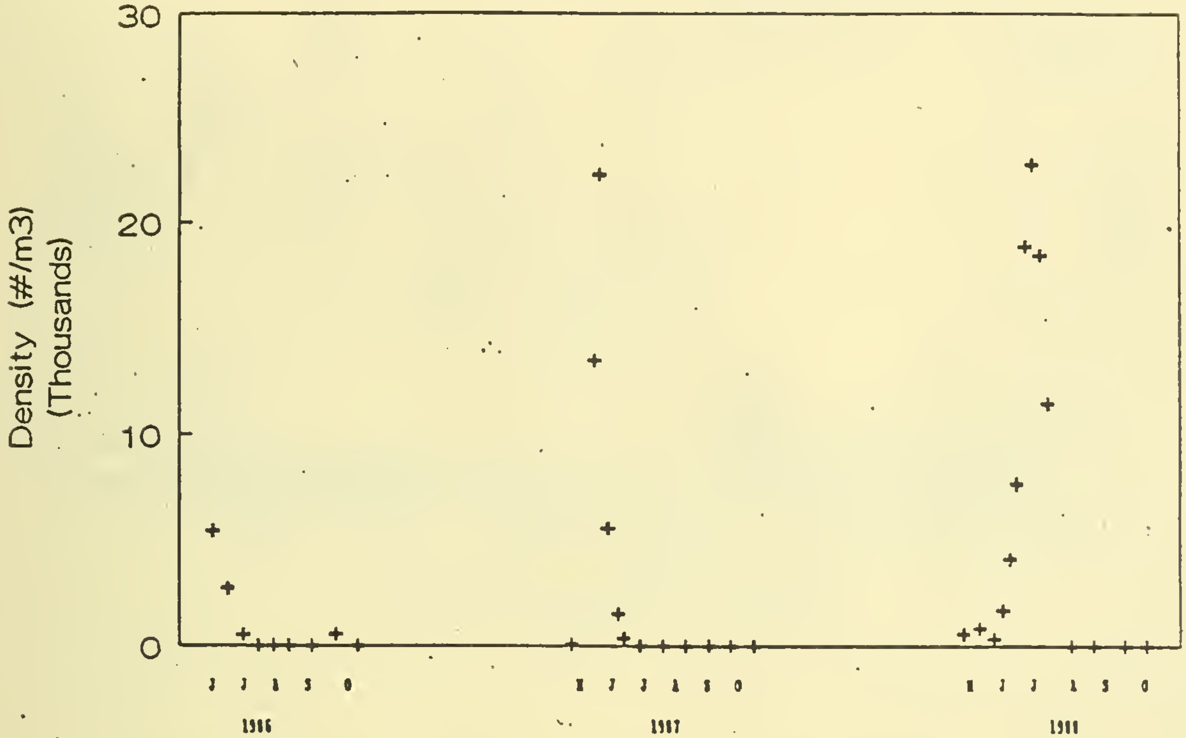
Density of Chydorus sphaericus
Rice Lake - Station R36



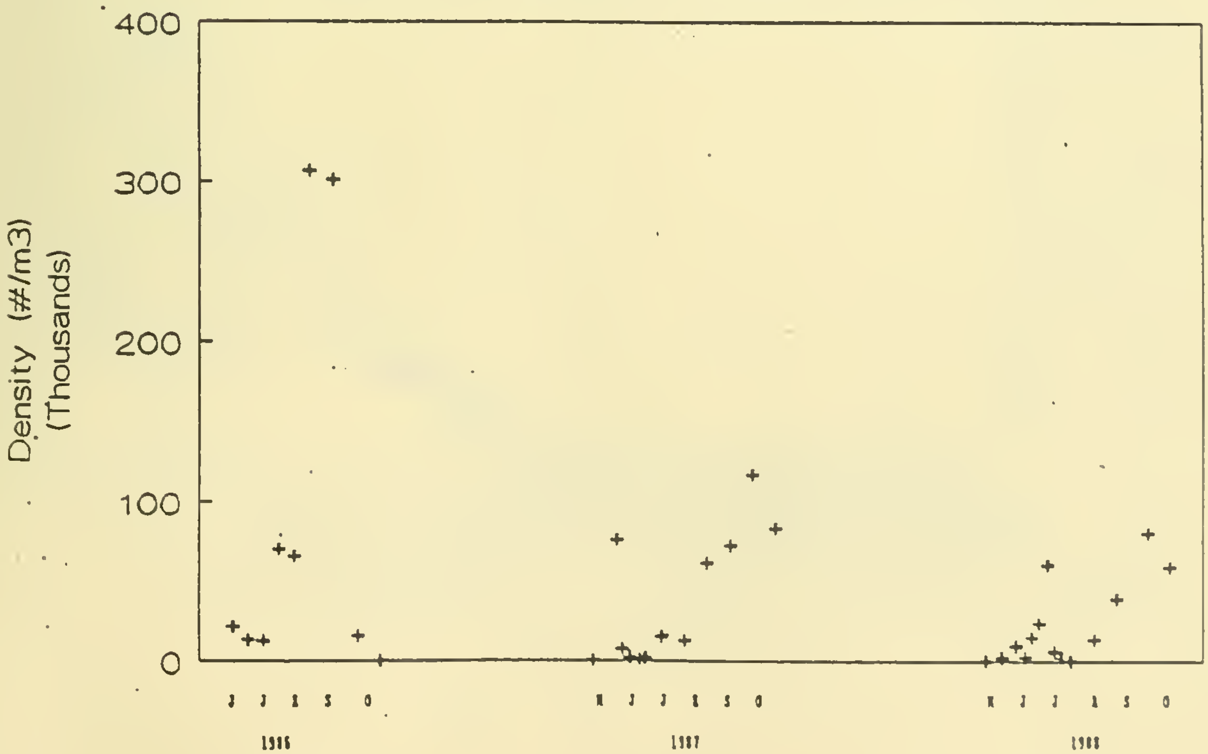
Density of Daphnia galeata mendotae
Rice Lake - Station R36



Density of Daphnia pulex
Rice Lake - Station R36

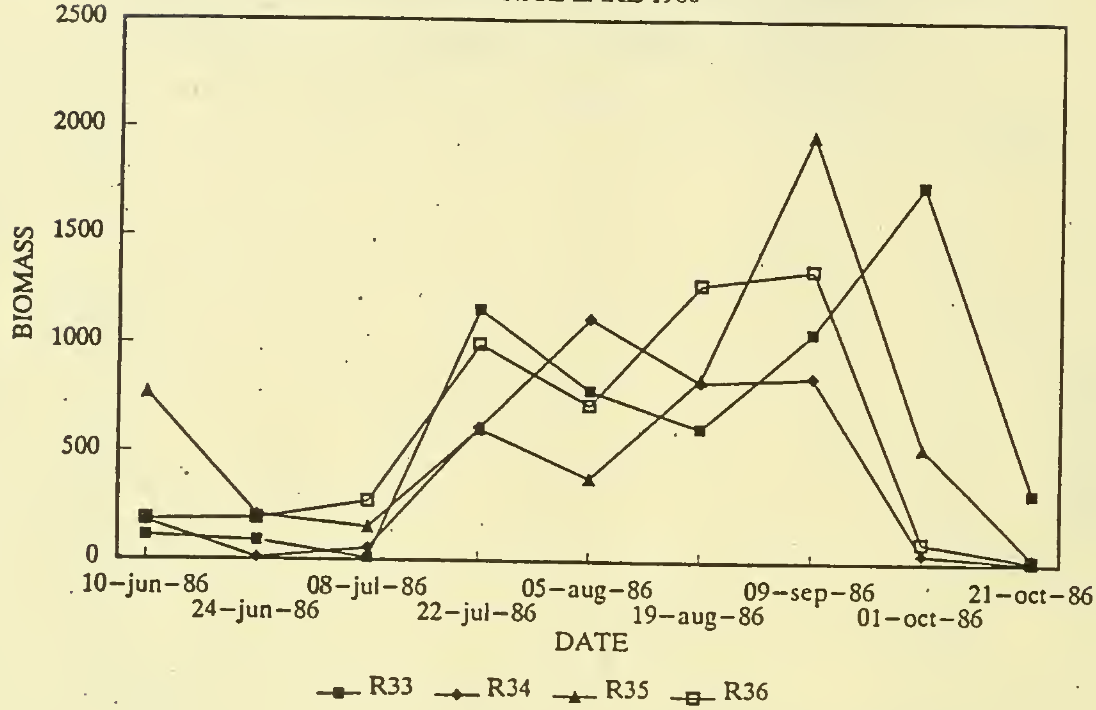


Density of Eubosmina coregoni
Rice Lake - Station R36



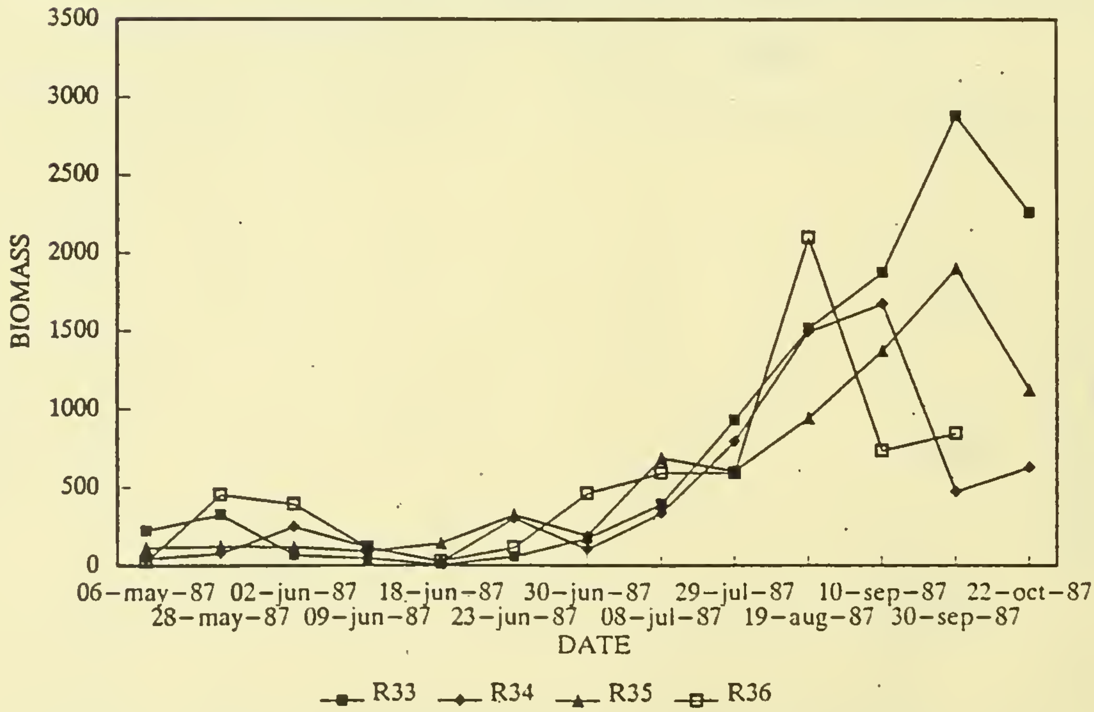
TOTAL ZOOPLANKTON BIOMASS

RICE LAKE 1986



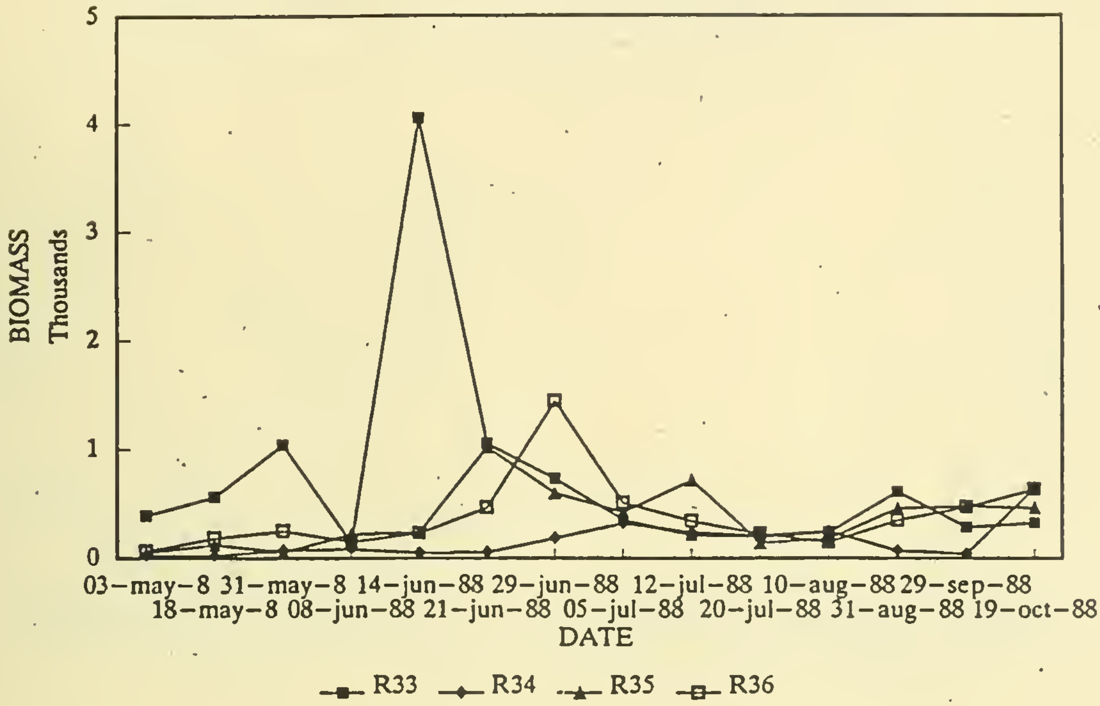
TOTAL ZOOPLANKTON BIOMASS

RICE LAKE 1987



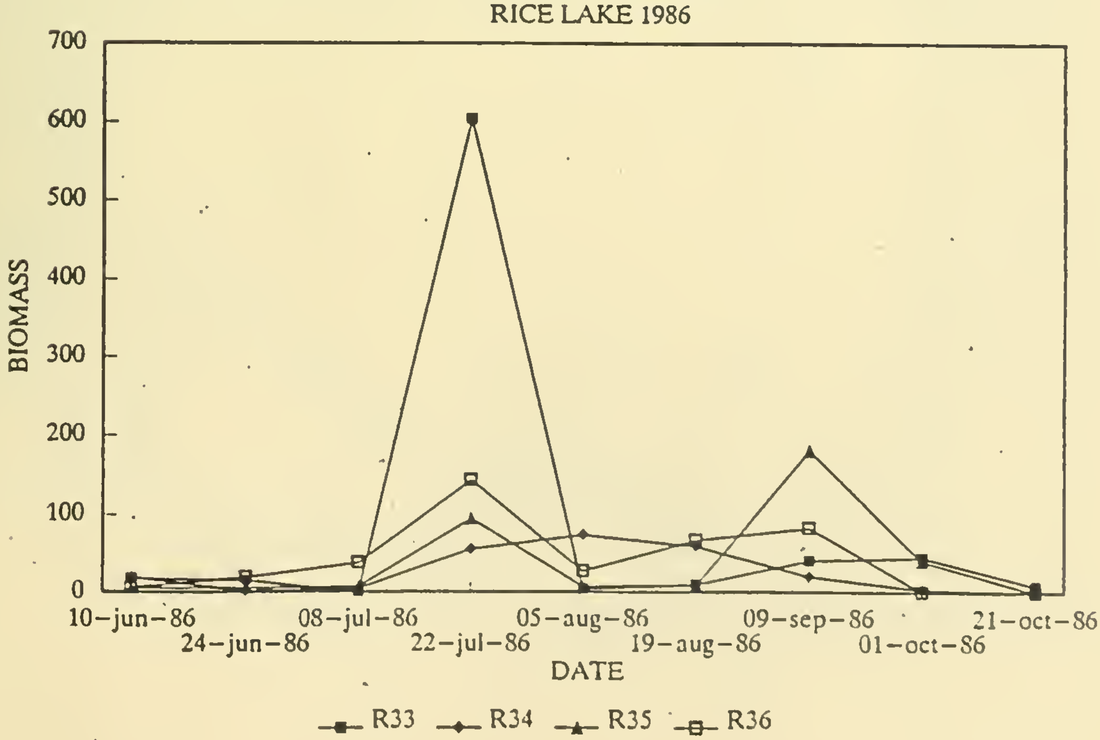
TOTAL ZOOPLANKTON BIOMASS

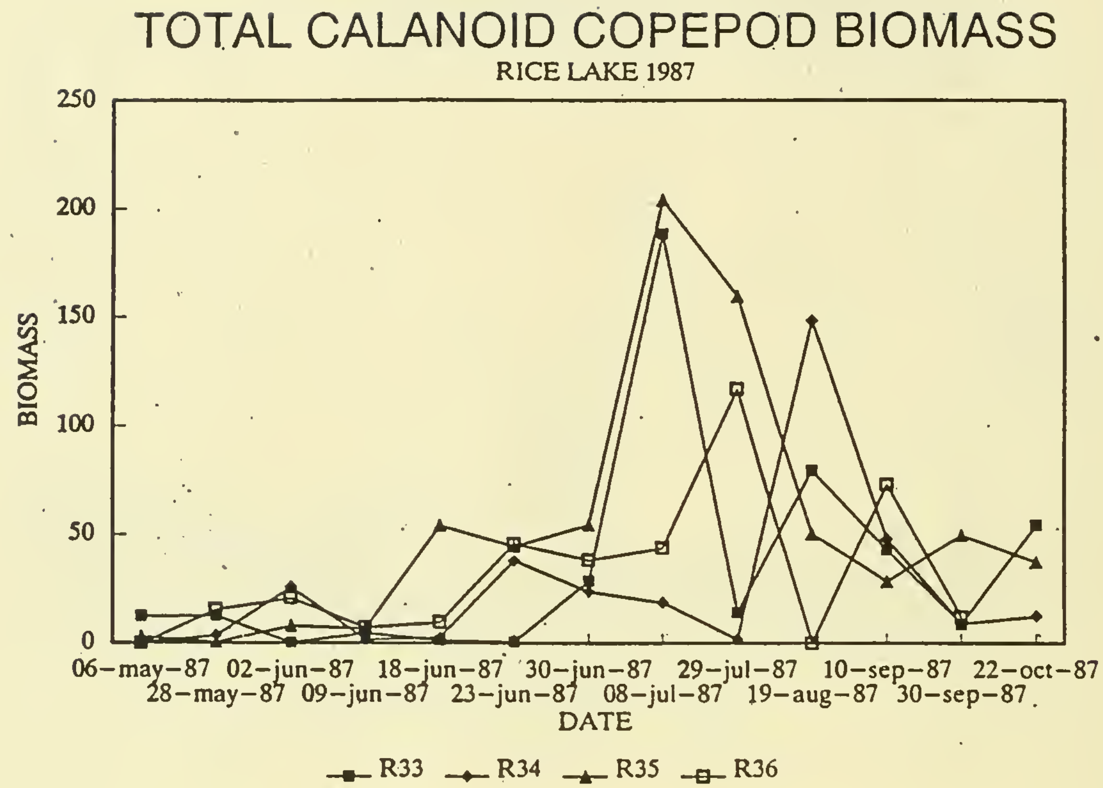
RICE LAKE 1988

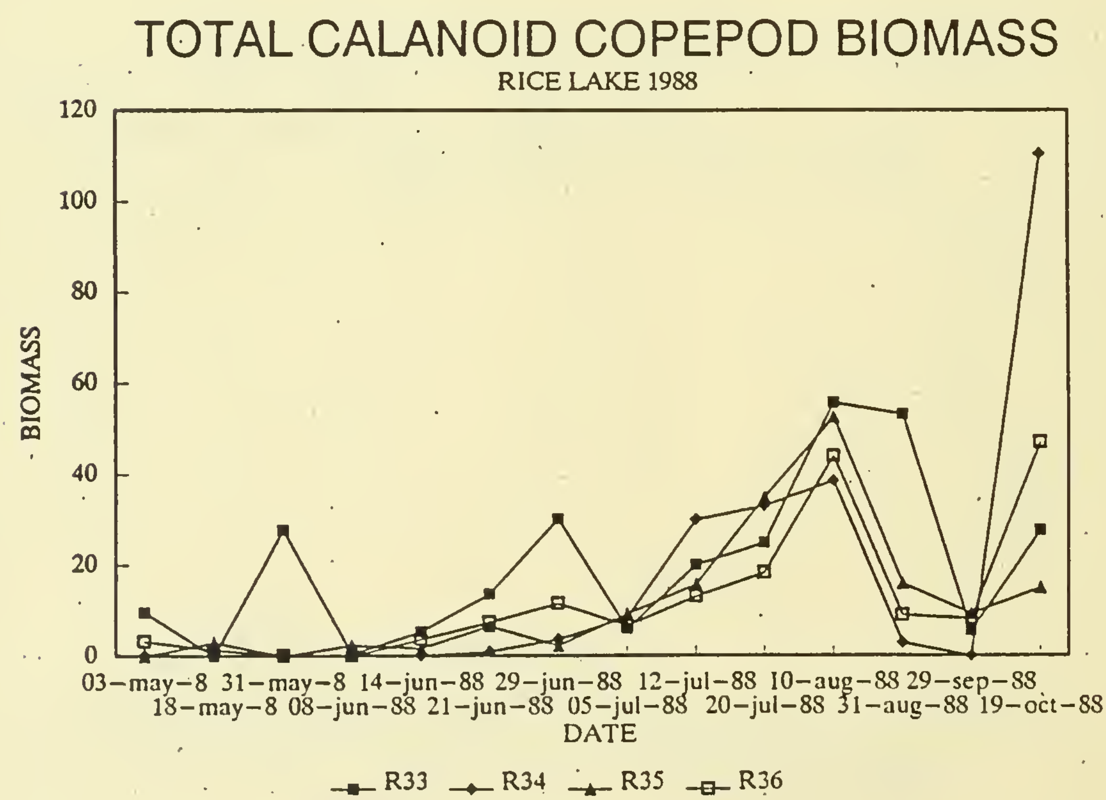


TOTAL CALANOID COPEPOD BIOMASS

RICE LAKE 1986

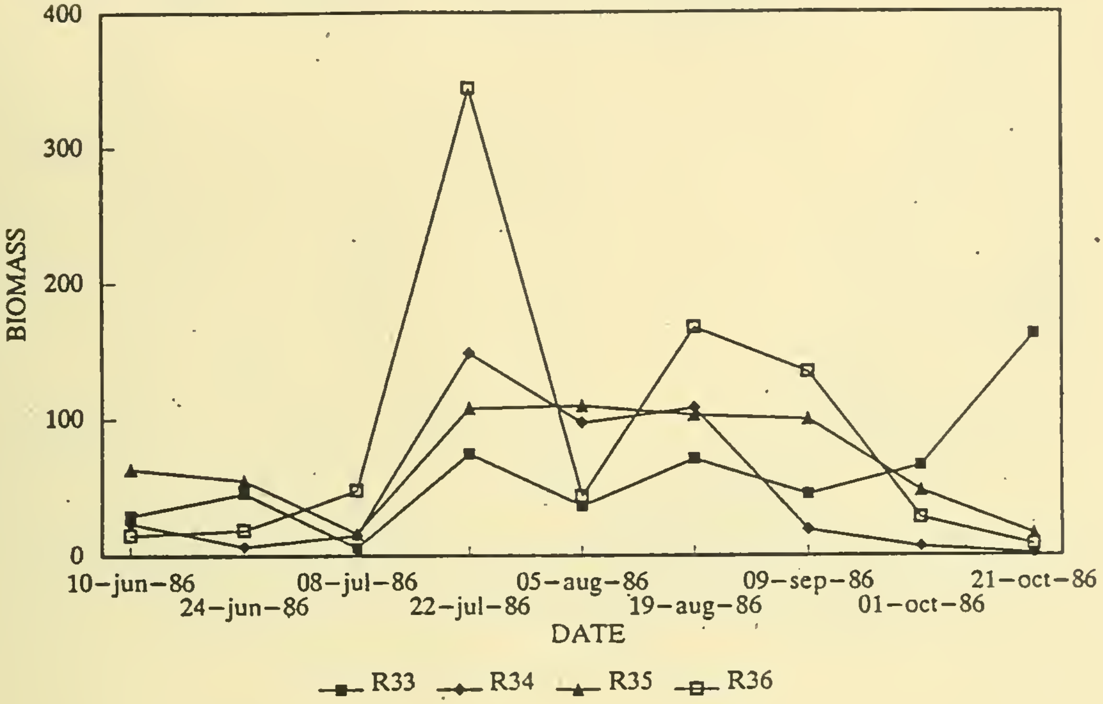



TOTAL CALANOID COPEPOD BIOMASS
RICE LAKE 1987
BIOMASS
250
200
150
100
50
0
06-may-87 02-jun-87 18-jun-87 30-jun-87 29-jul-87 10-sep-87 22-oct-87
28-may-87 09-jun-87 23-jun-87 08-jul-87 19-aug-87 30-sep-87
DATE
R33 R34 R35 R36


TOTAL CALANOID COPEPOD BIOMASS
RICE LAKE 1988
BIOMASS
120
100
80
60
40
20
0
03-may-8 31-may-8 14-jun-88 29-jun-88 12-jul-88 10-aug-88 29-sep-88
18-may-8 08-jun-88 21-jun-88 05-jul-88 20-jul-88 31-aug-88 19-oct-88
DATE
R33 R34 R35 R36

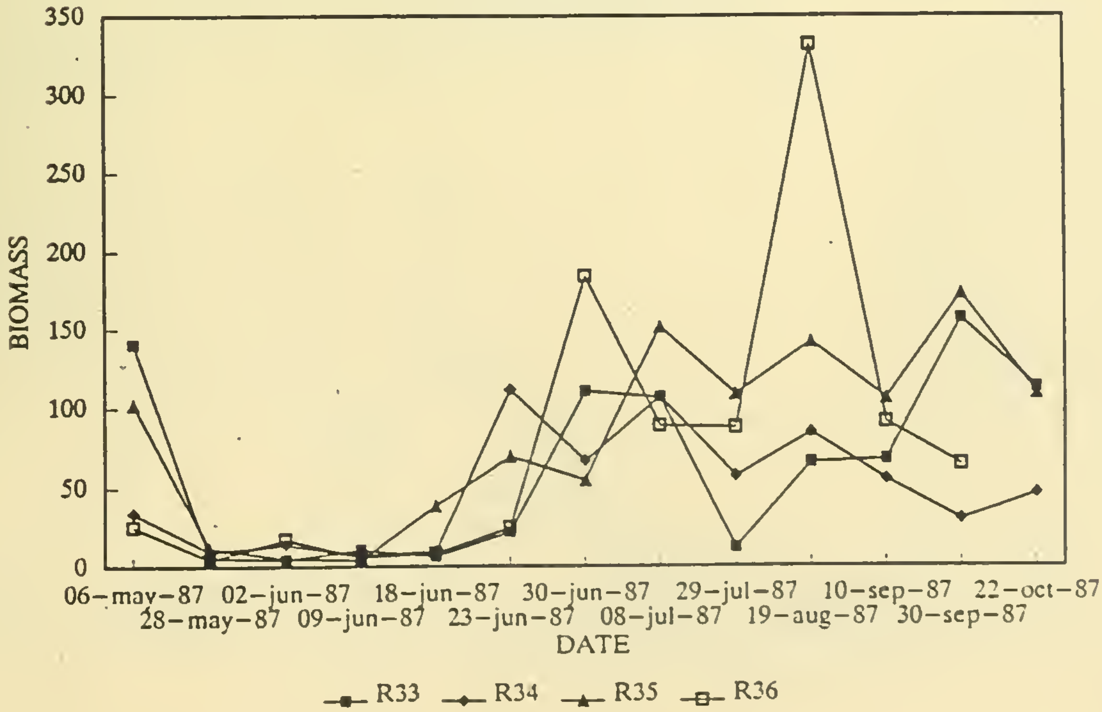
TOTAL CYCLOPOID COPEPOD BIOMASS

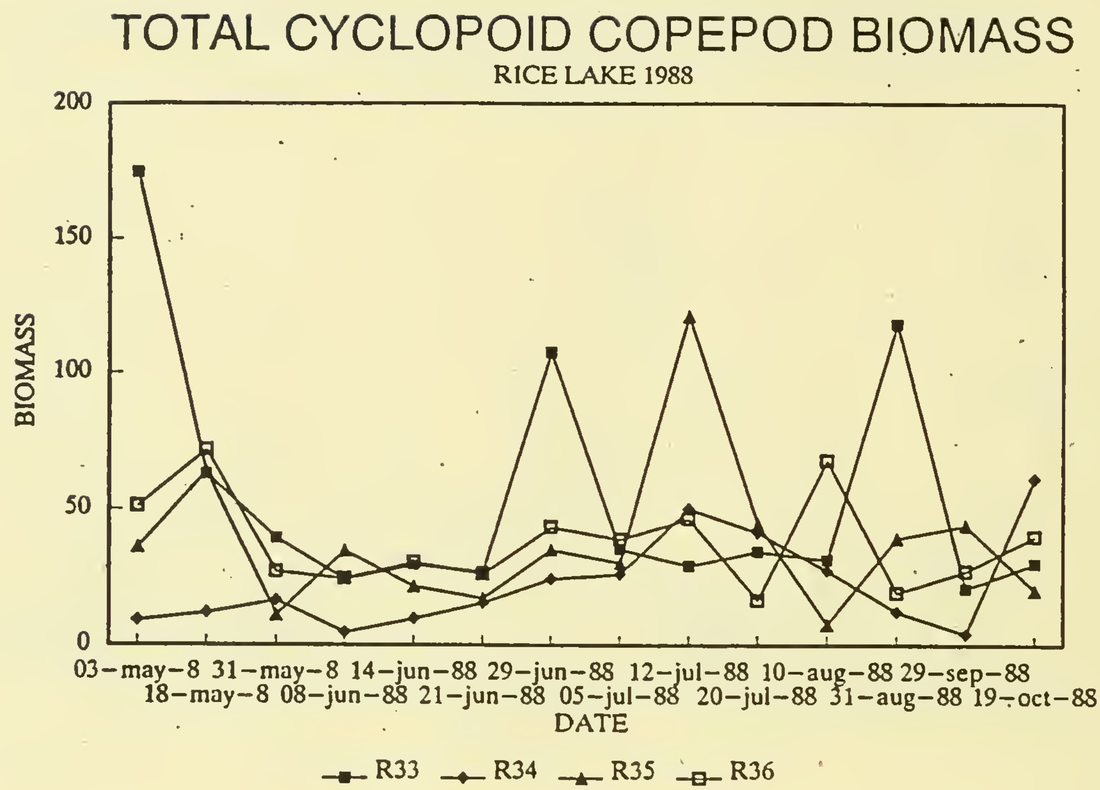
RICE LAKE 1986



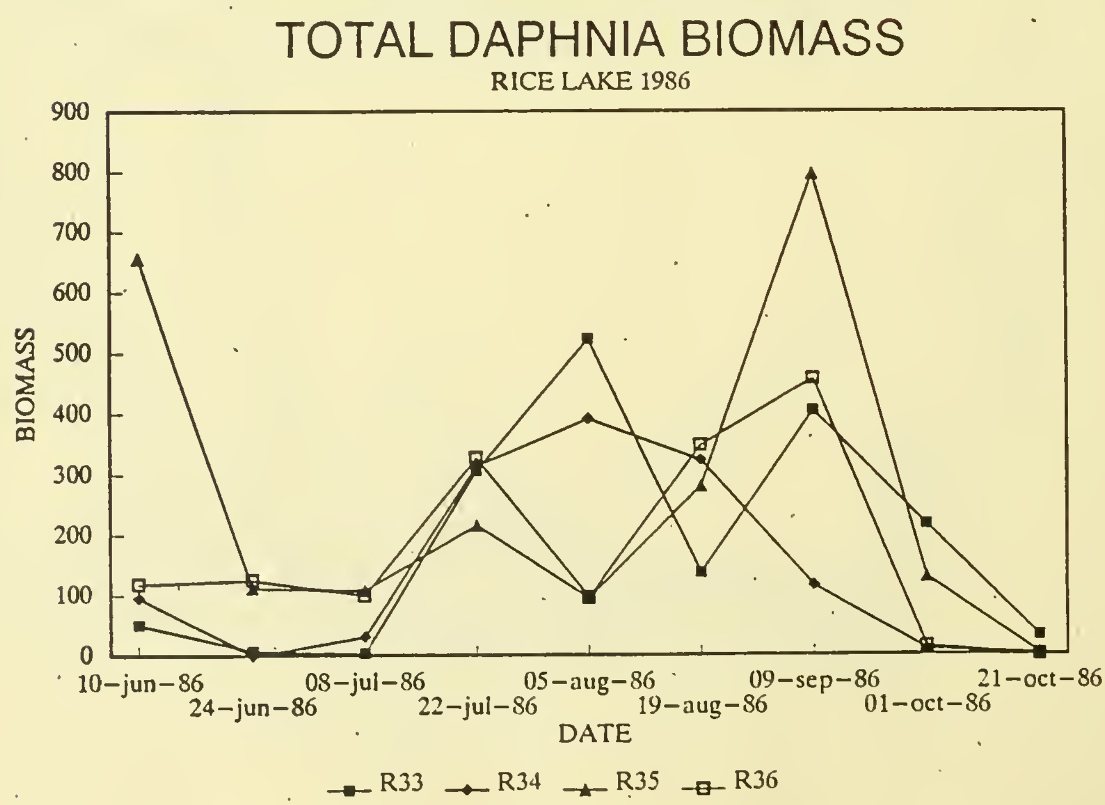
TOTAL CYCLOPOID COPEPOD BIOMASS

RICE LAKE 1987

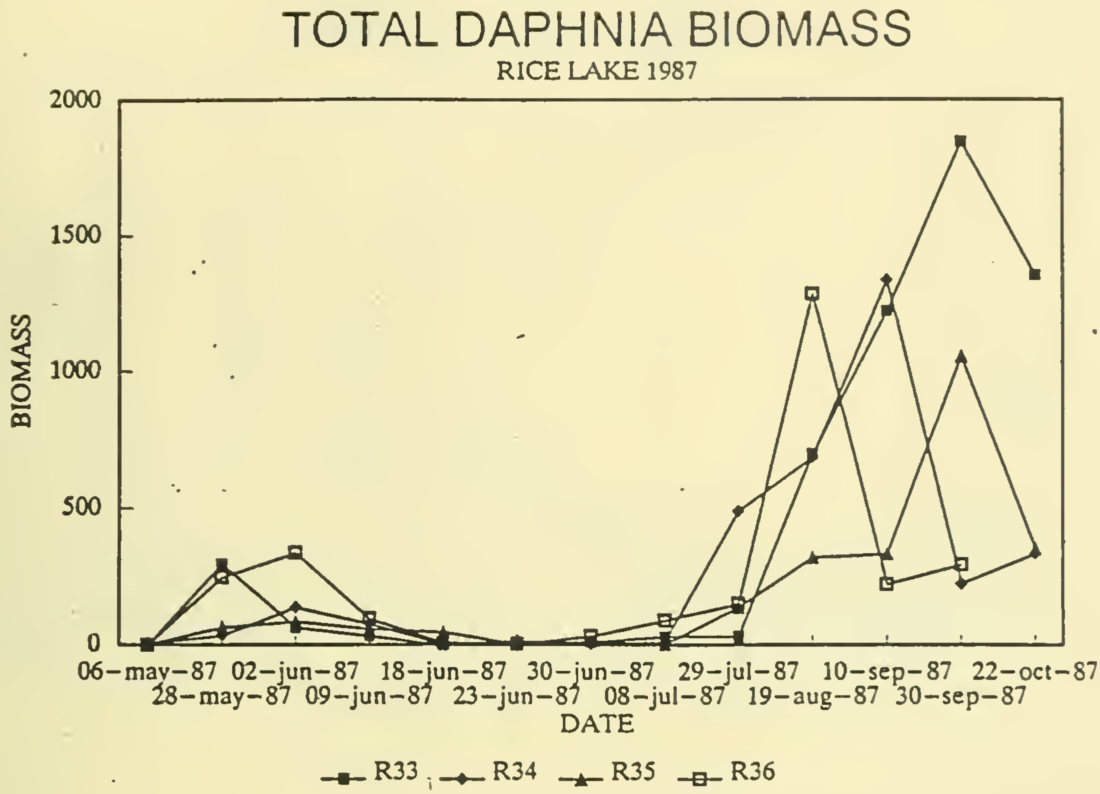


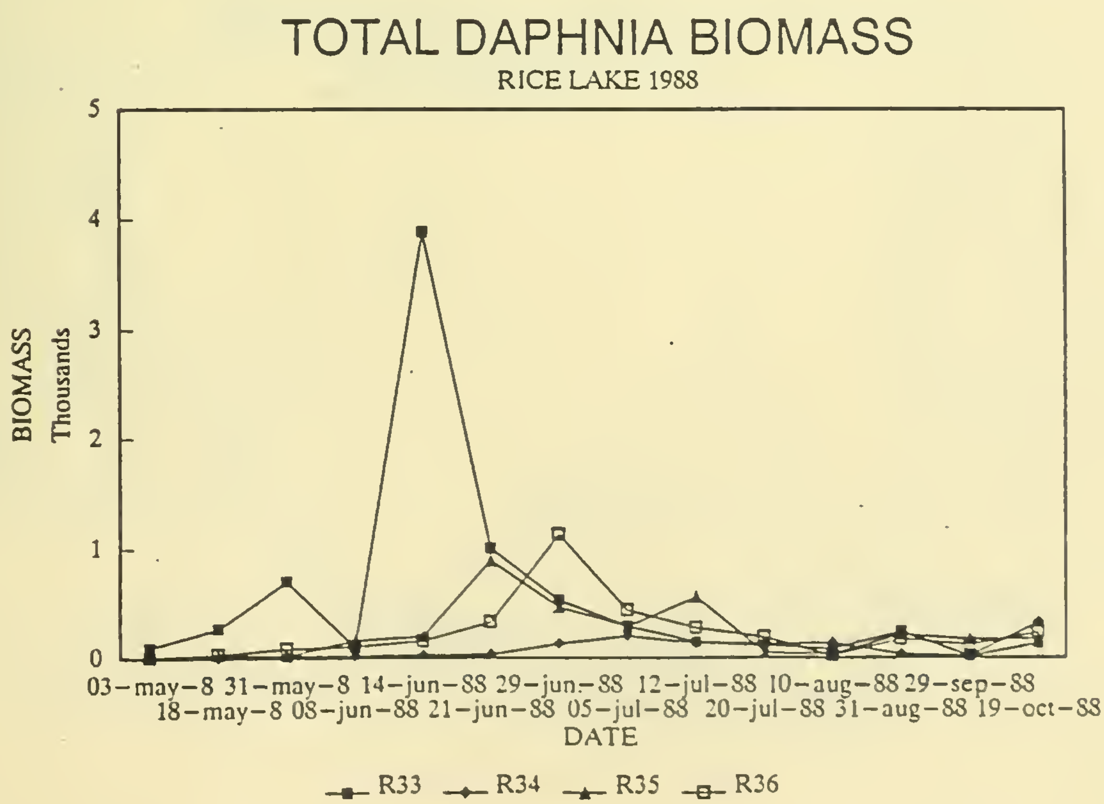


TOTAL CYCLOPOID COPEPOD BIOMASS
RICE LAKE 1988
BIOMASS
0
50
100
150
200
03-may-8
18-may-8
31-may-8
08-jun-88
14-jun-88
21-jun-88
29-jun-88
05-jul-88
12-jul-88
20-jul-88
10-aug-88
31-aug-88
29-sep-88
19-oct-88
DATE
R33
R34
R35
R36



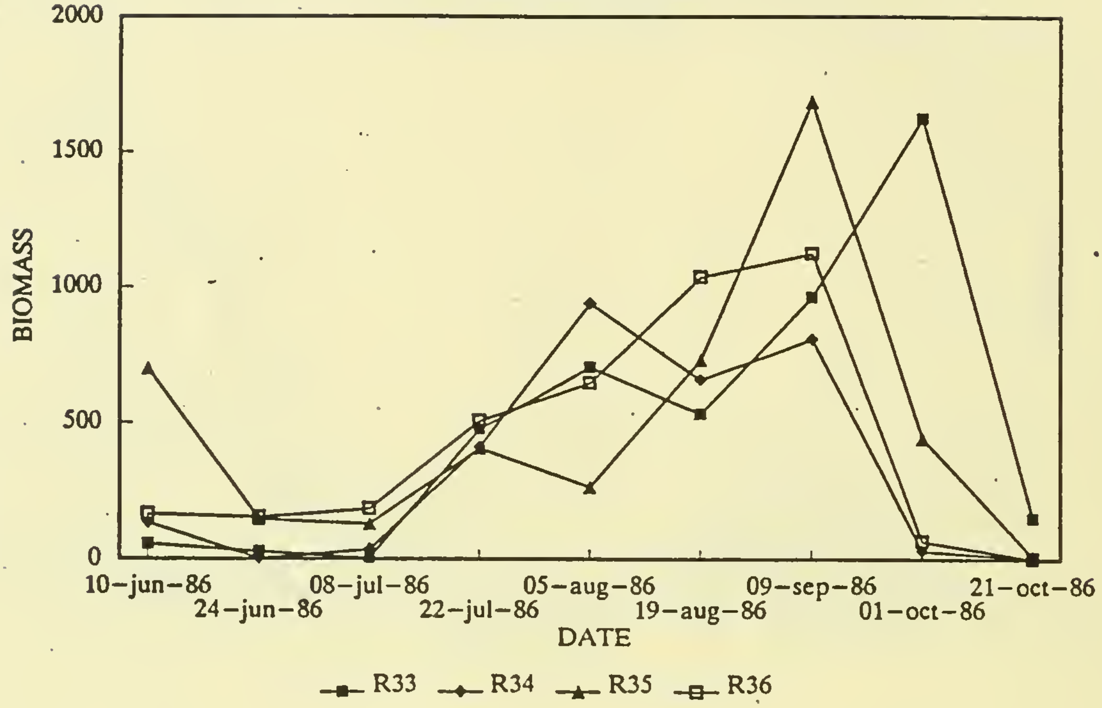
TOTAL DAPHNIA BIOMASS
RICE LAKE 1986
BIOMASS
0
100
200
300
400
500
600
700
800
900
10-jun-86
24-jun-86
08-jul-86
22-jul-86
05-aug-86
19-aug-86
09-sep-86
01-oct-86
21-oct-86
DATE
R33
R34
R35
R36


TOTAL DAPHNIA BIOMASS
RICE LAKE 1987
BIOMASS
2000
1500
1000
500
0
06-may-87 02-jun-87 18-jun-87 30-jun-87 29-jul-87 10-sep-87 22-oct-87
28-may-87 09-jun-87 23-jun-87 08-jul-87 19-aug-87 30-sep-87
DATE
R33 R34 R35 R36


TOTAL DAPHNIA BIOMASS
RICE LAKE 1988
BIOMASS
Thousands
5
4
3
2
1
0
03-may-8 31-may-8 14-jun-88 29-jun-88 12-jul-88 10-aug-88 29-sep-88
18-may-8 08-jun-88 21-jun-88 05-jul-88 20-jul-88 31-aug-88 19-oct-88
DATE
R33 R34 R35 R36

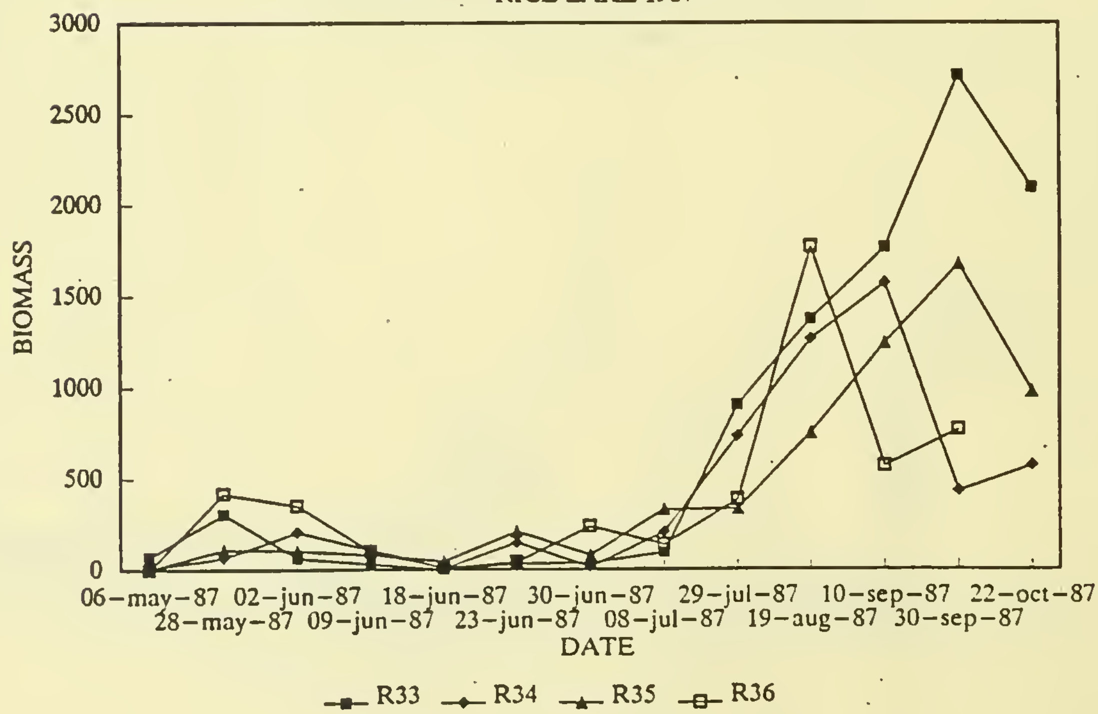
TOTAL CLADOCERA

RICE LAKE 1986



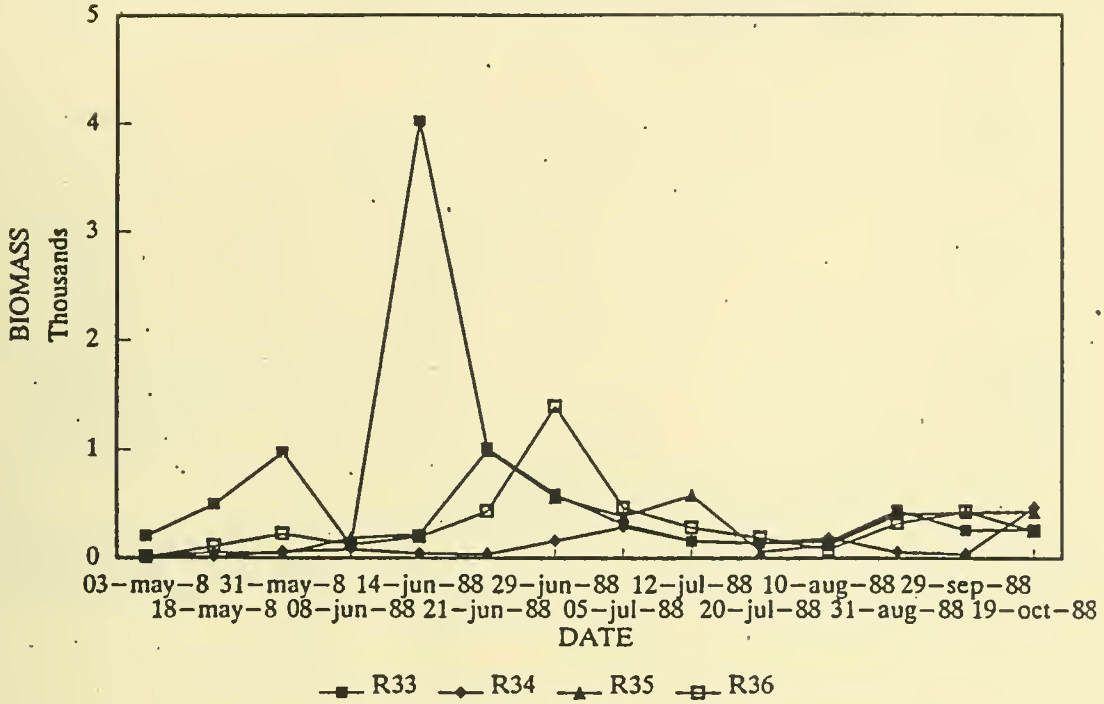
TOTAL CLADOCERA

RICE LAKE 1987



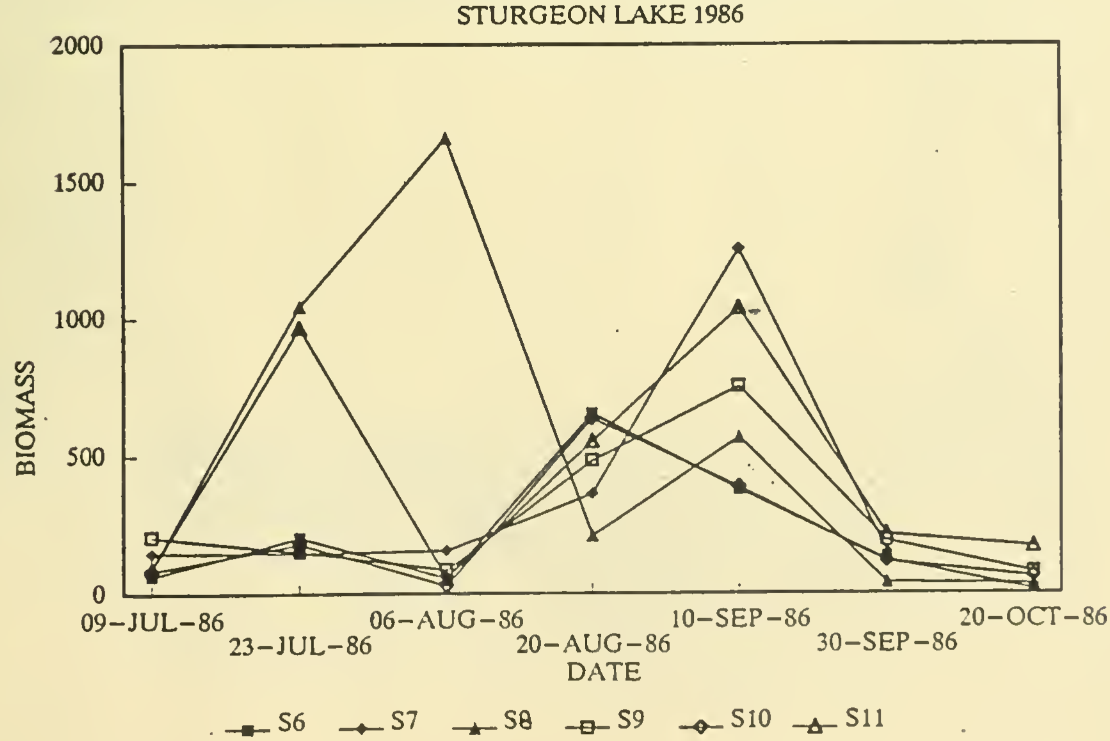
TOTAL CLADOCERA

RICE LAKE 1988



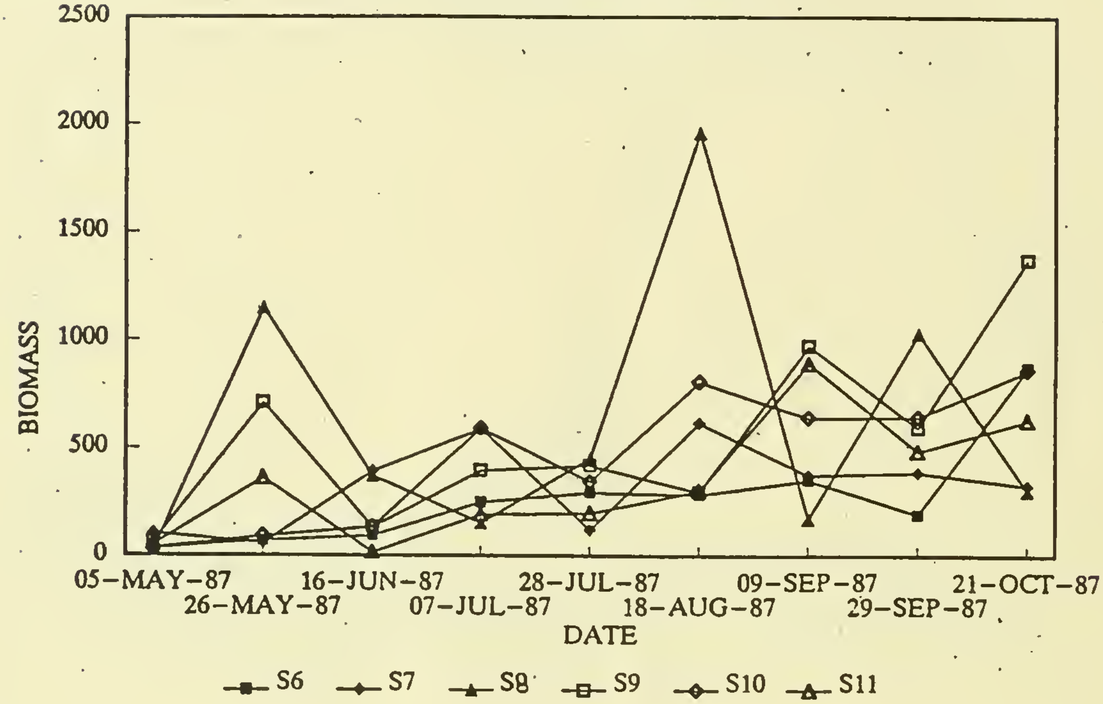
TOTAL ZOOPLANKTON BIOMASS

STURGEON LAKE 1986



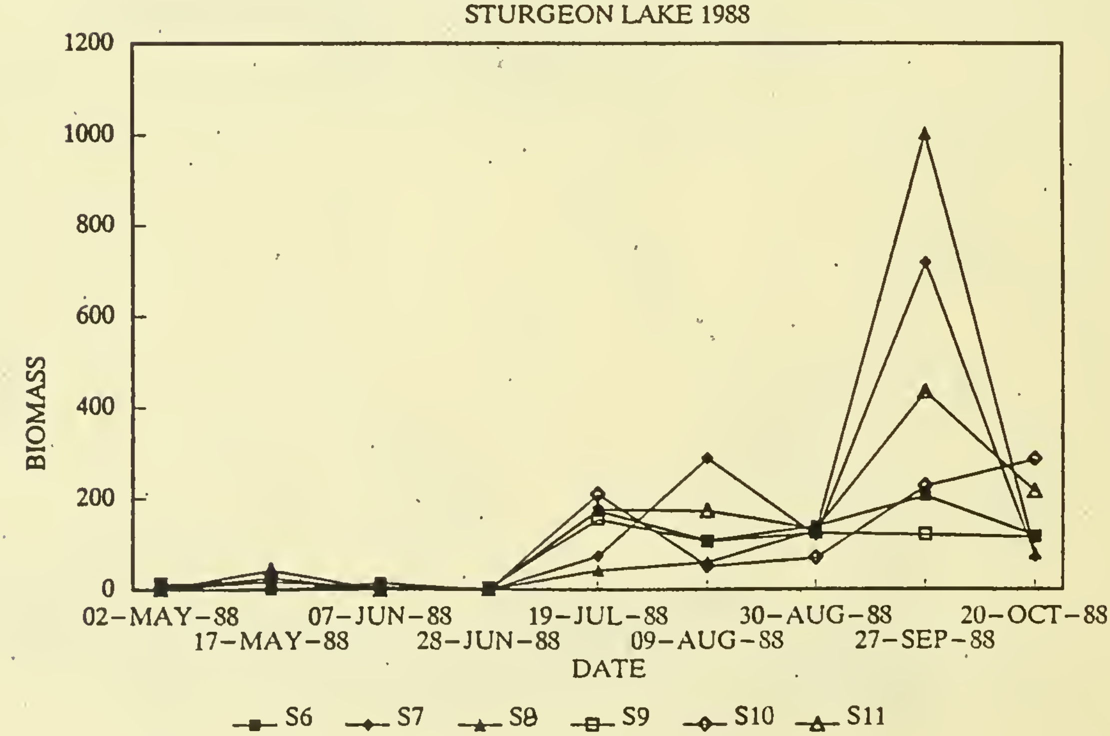
TOTAL ZOOPLANKTON BIOMASS

STURGEON LAKE 1987



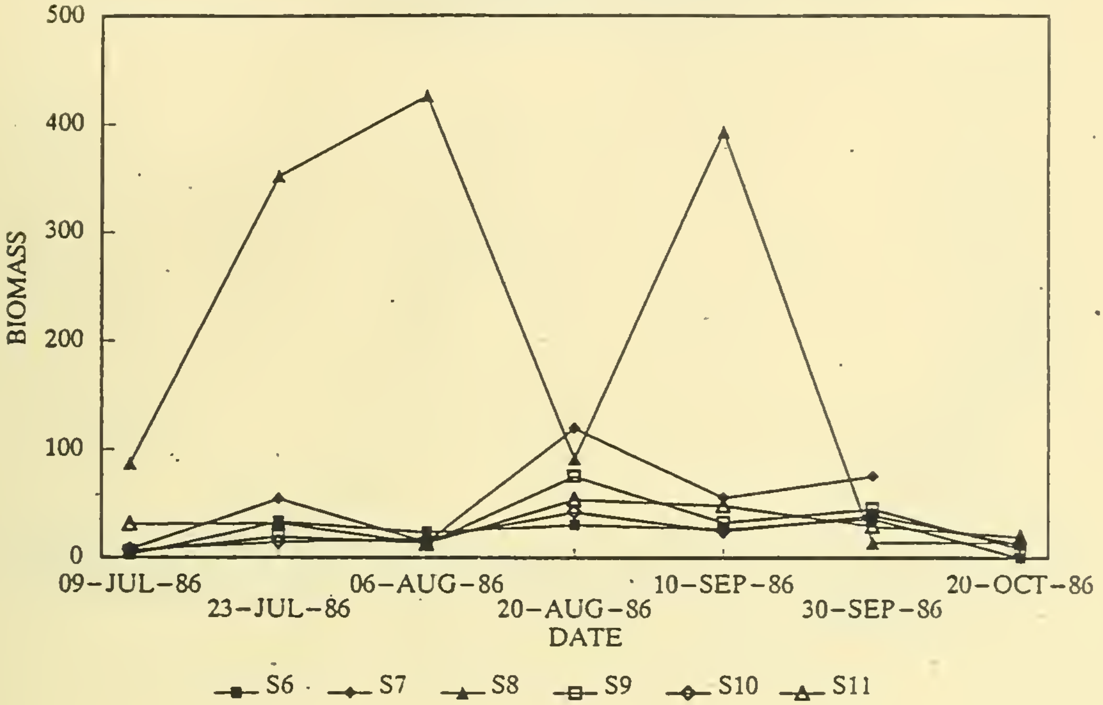
TOTAL ZOOPLANKTON BIOMASS

STURGEON LAKE 1988



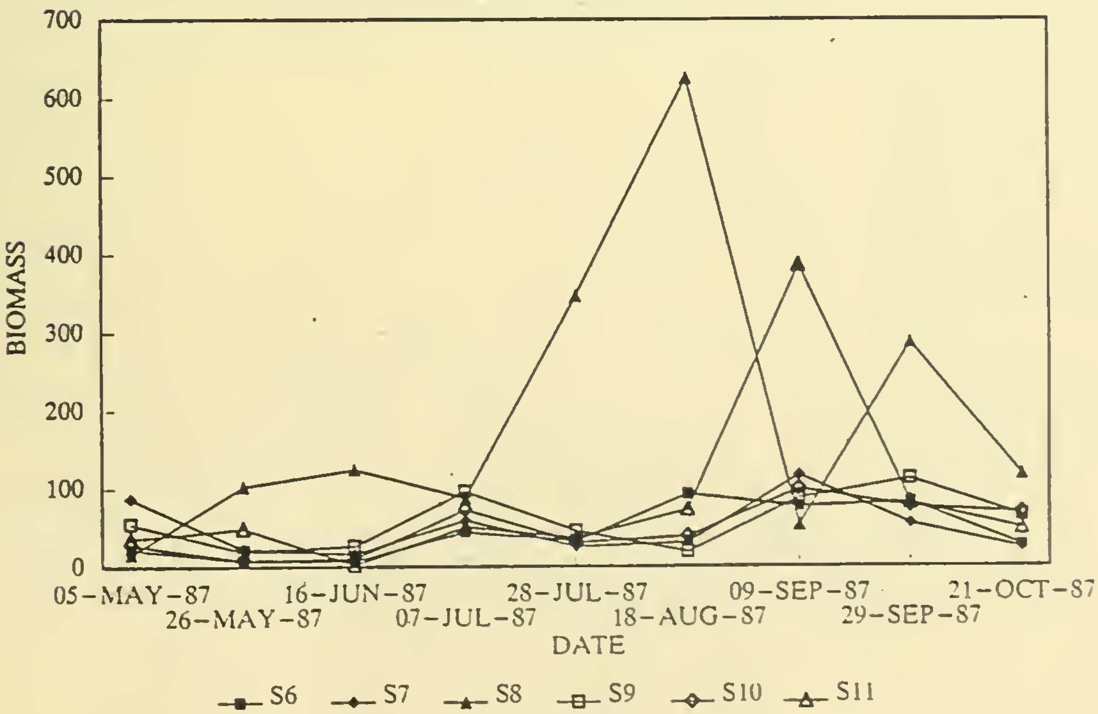
TOTAL CYCLOPOID COPEPOD BIOMASS

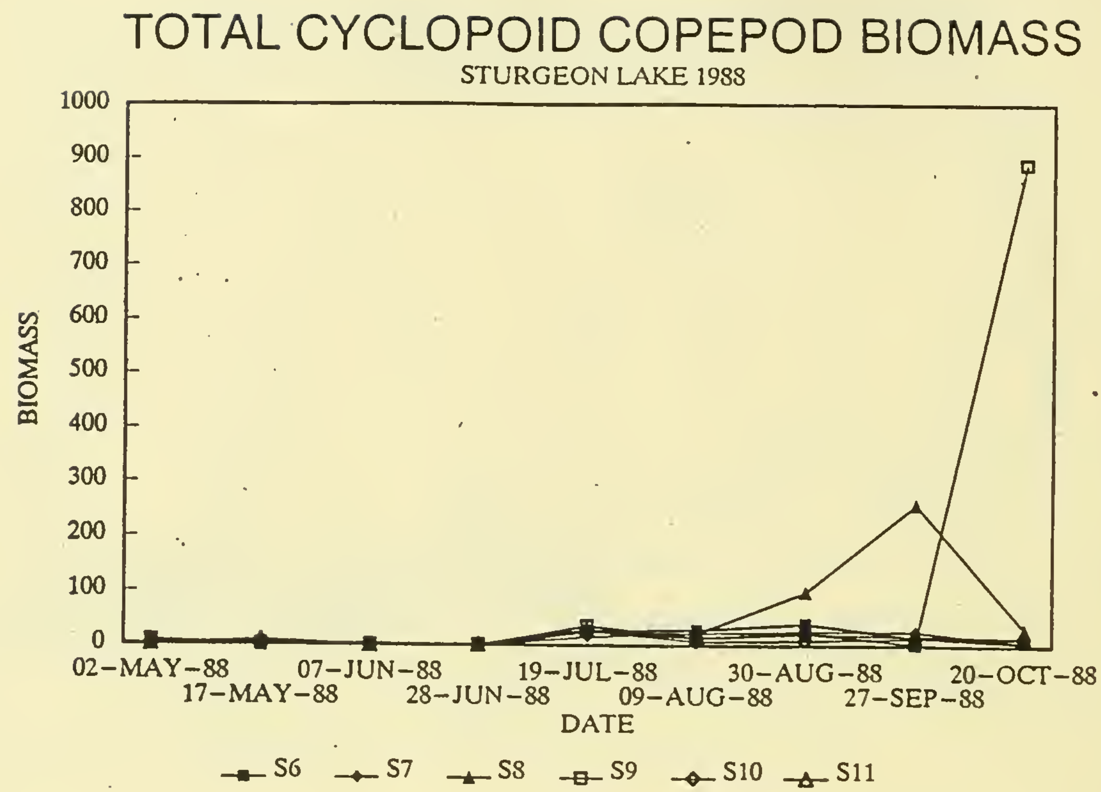
STURGEON LAKE 1986

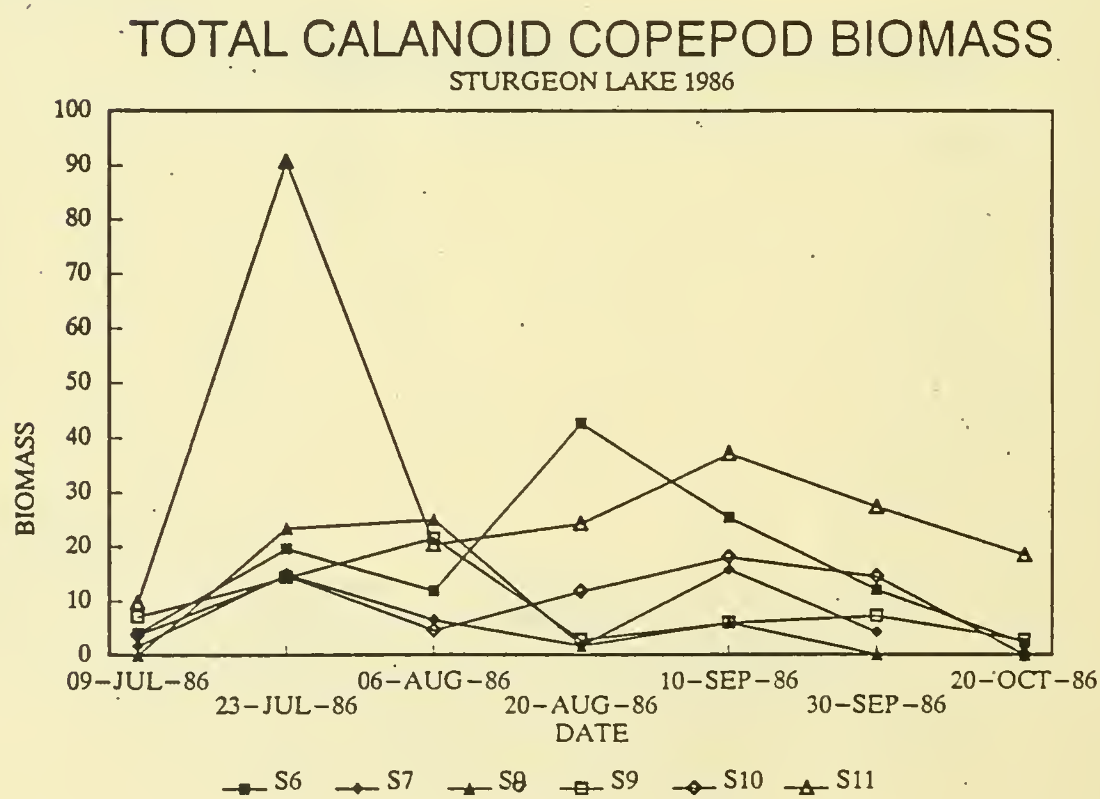


TOTAL CYCLOPOID COPEPOD BIOMASS

STURGEON LAKE 1987

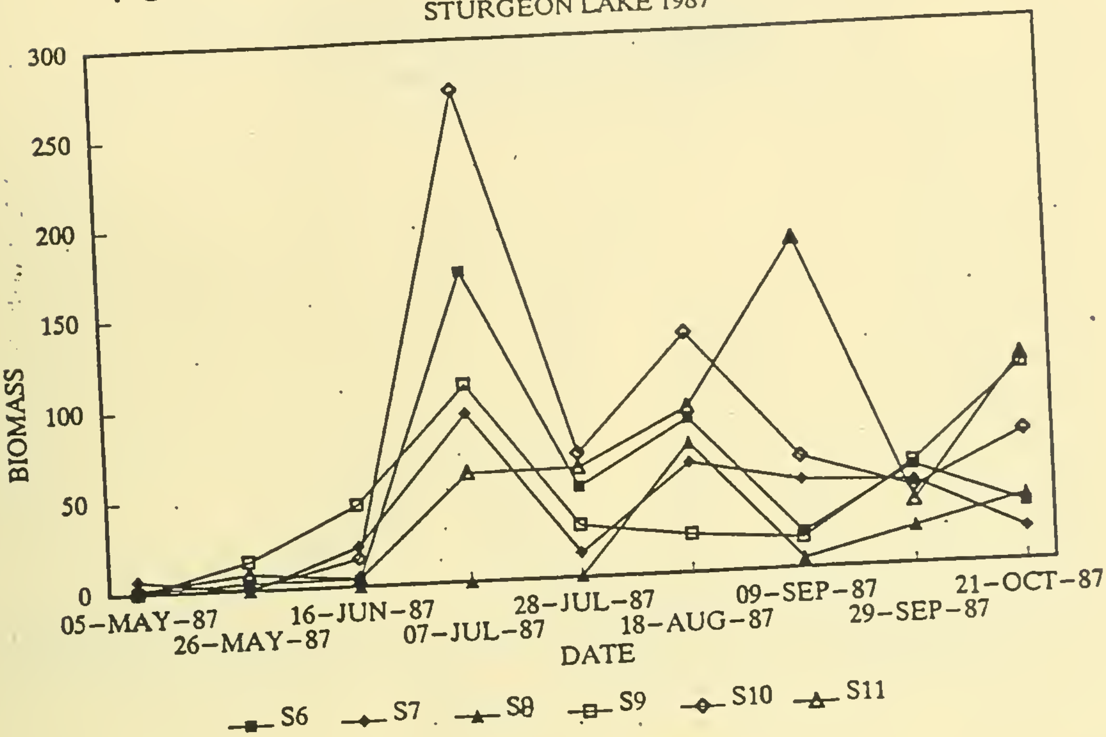



TOTAL CYCLOPOID COPEPOD BIOMASS
STURGEON LAKE 1988
BIOMASS
1000
900
800
700
600
500
400
300
200
100
0
02-MAY-88
17-MAY-88
07-JUN-88
28-JUN-88
19-JUL-88
09-AUG-88
30-AUG-88
27-SEP-88
20-OCT-88
DATE
S6
S7
S8
S9
S10
S11


TOTAL CALANOID COPEPOD BIOMASS
STURGEON LAKE 1986
BIOMASS
100
90
80
70
60
50
40
30
20
10
0
09-JUL-86
23-JUL-86
06-AUG-86
20-AUG-86
10-SEP-86
30-SEP-86
20-OCT-86
DATE
S6
S7
S8
S9
S10
S11

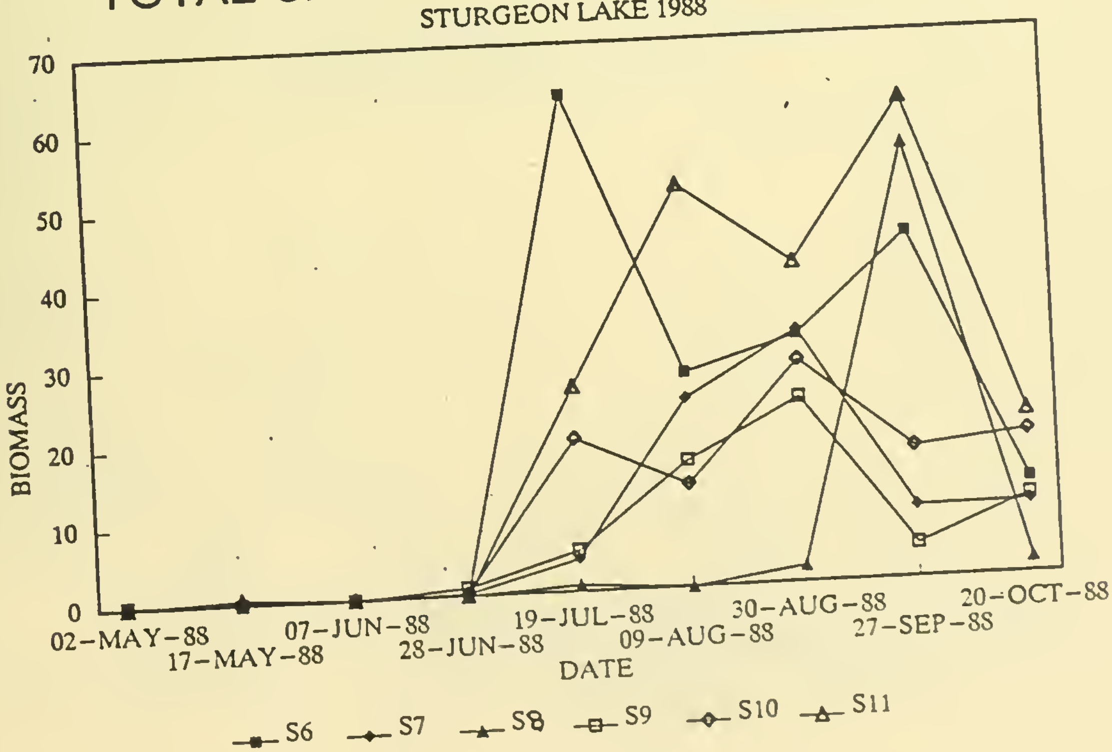
TOTAL CALANOID COPEPOD BIOMASS

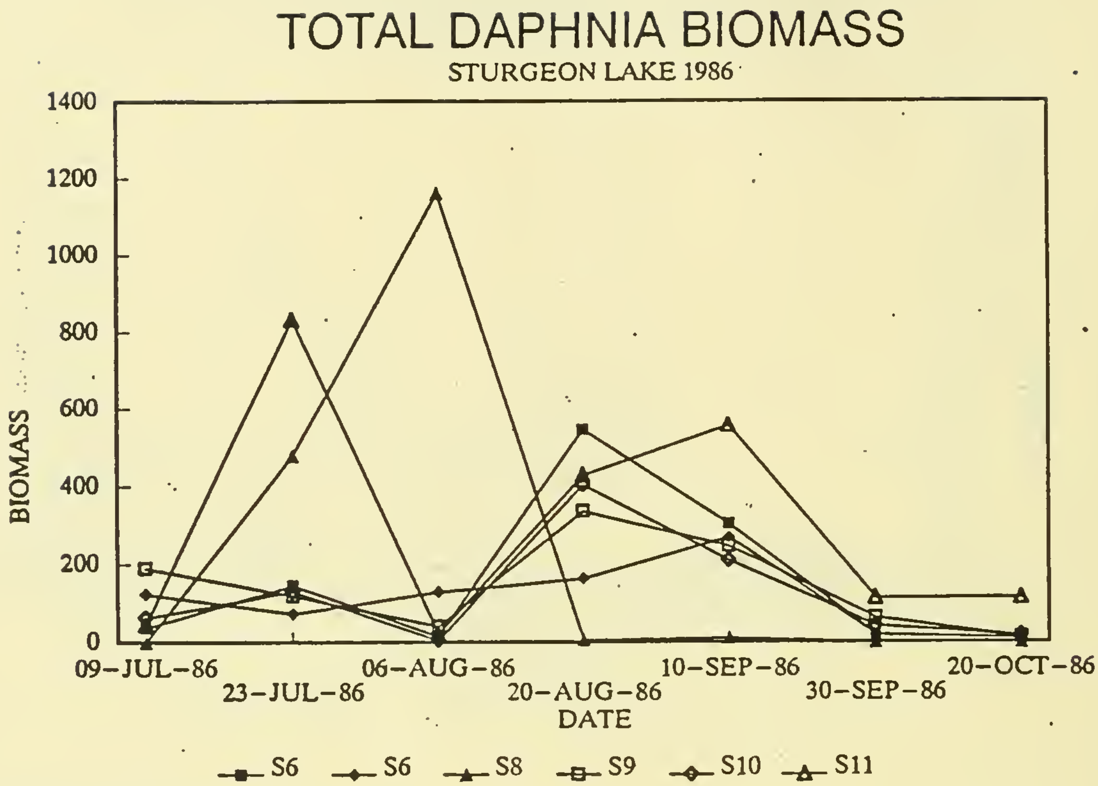
STURGEON LAKE 1987



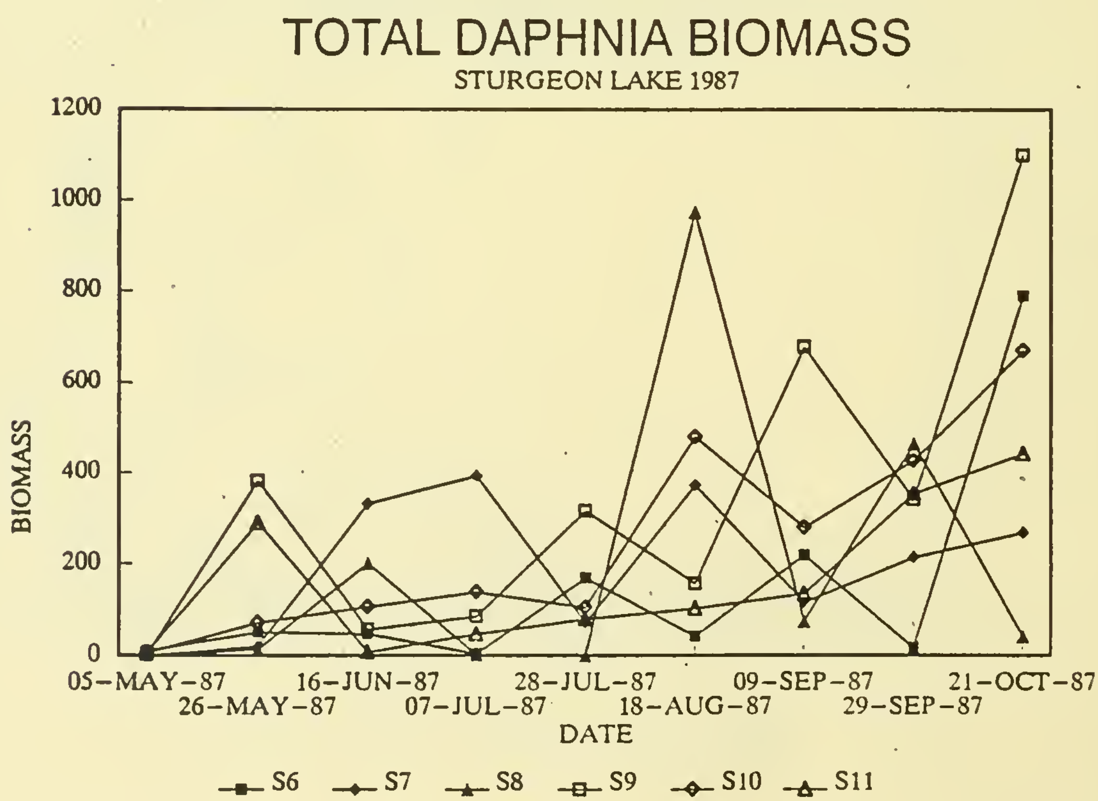
TOTAL CALANOID COPEPOD BIOMASS

STURGEON LAKE 1988





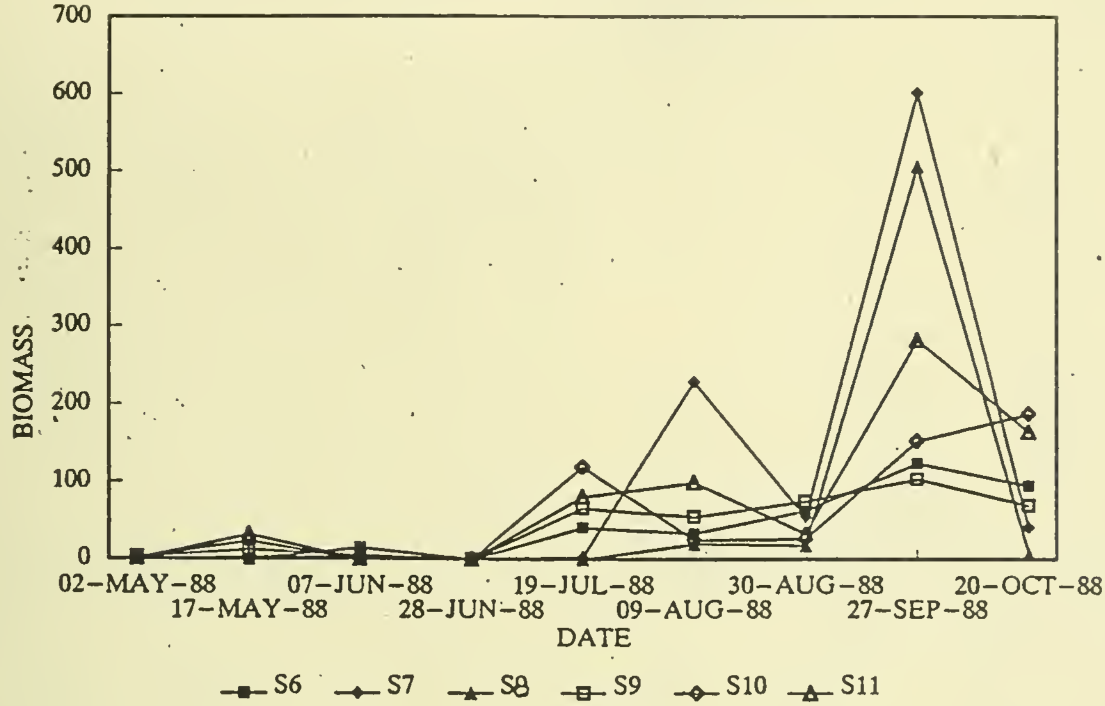
TOTAL DAPHNIA BIOMASS
STURGEON LAKE 1986
1400
1200
1000
800
600
400
200
0
BIOMASS
09-JUL-86
23-JUL-86
06-AUG-86
20-AUG-86
10-SEP-86
30-SEP-86
20-OCT-86
DATE
S6
S6
S8
S9
S10
S11



TOTAL DAPHNIA BIOMASS
STURGEON LAKE 1987
1200
1000
800
600
400
200
0
BIOMASS
05-MAY-87
26-MAY-87
16-JUN-87
07-JUL-87
28-JUL-87
18-AUG-87
09-SEP-87
29-SEP-87
21-OCT-87
DATE
S6
S7
S8
S9
S10
S11

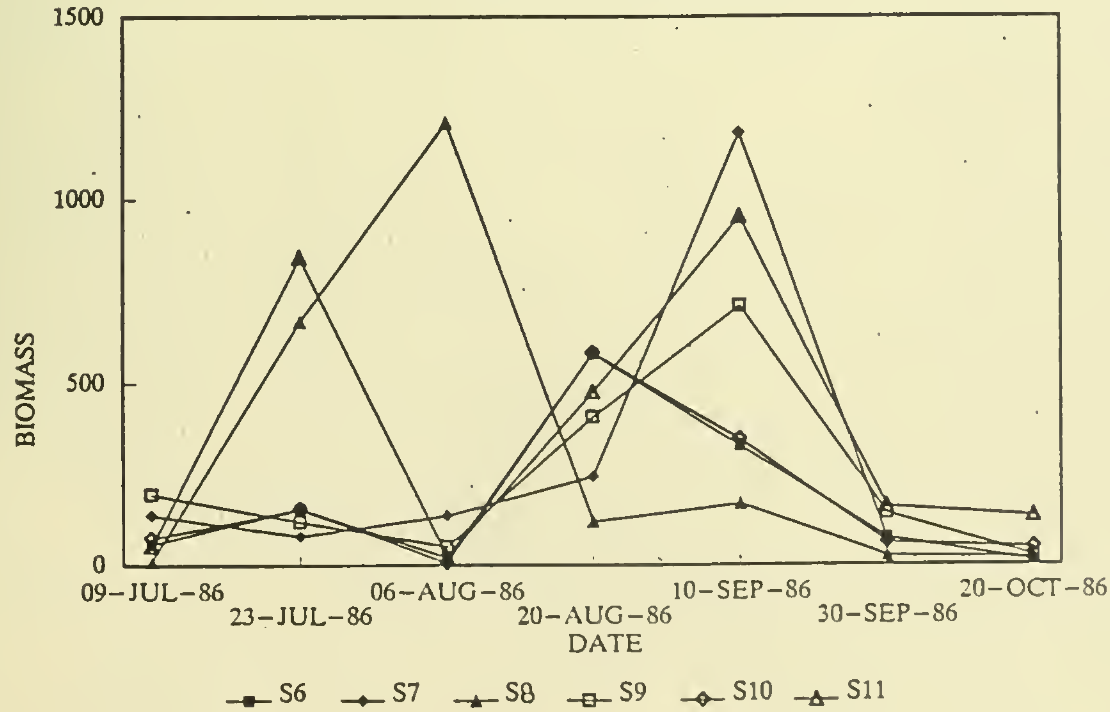
TOTAL DAPHNIA BIOMASS

STURGEON LAKE 1988



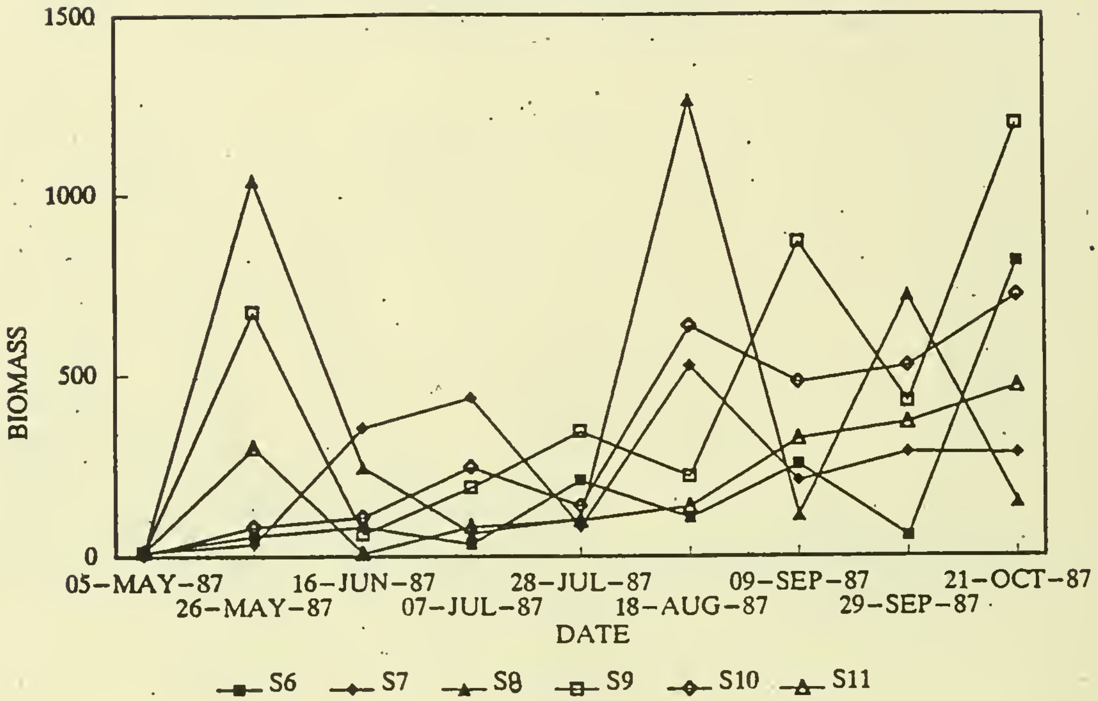
TOTAL CLADOCERAN BIOMASS

STURGEON LAKE 1986



TOTAL CLADOCERAN BIOMASS

STURGEON LAKE 1987



TOTAL CLADOCERAN BIOMASS

STURGEON LAKE 1988